THE EFFECTS OF THE INTENSITY OF PHONOLOGICAL AWARENESS INSTRUCTION ON THE ACQUISITION OF LITERACY SKILLS

By

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THE EFFECTS OF THE INTENSITY OF PHONOLOGICAL AWARENESS INSTRUCTION ON THE ACQUISITION OF LITERACY SKILLS

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This study focused on the effect of an increase in intensity of instruction in phonological awareness (PA) on the acquisition of literacy skills of kindergarten students. In addition, the study investigated the frequency of students scoring below the 30th percentile for each of the groups and the frequency of students with a double-deficit in PA and rapid naming scoring below the 30th percentile in literacy skills.

The participants in the study were 105 kindergarten children in north central Florida. The students were assigned to one of three groups: (a) a treatment group, which received a Direct Instruction (DI) reading program supplemented by a program in PA; (b) Comparison Group A, which received instruction in DI alone; or (c) Comparison Group B, which only received instruction in PA.

The findings of the study indicate that the treatment group attained significant mean gains in rapid naming, nonword, and word reading fluency when compared to the gains of Comparison Group B. No other significant group differences were detected at the end of kindergarten, and no significant differences were detected at the end of first grade.

No significant differences were found in the frequency of students in each group scoring below the 30th percentile on literacy skills. However, the frequency of students with a double-deficit in PA and rapid naming, who scored below the 30th percentile on word and nonword reading fluency, reached significance, though nonword differences were significant when the double-deficit was detected at the middle, but not at the beginning, of kindergarten.

These findings are important for educators because the results of the study support the premise that increasing the intensity of instruction in PA may result in an increase in literacy skills for many students. However, students with reading disabilities may require even more intensive instruction than can be provided in a class-wide setting. The findings also support the hypothesis that the

intensity of instruction must be maintained for longer than a year for many students to achieve maximum growth in literacy skills.

CHAPTER 1
INTRODUCTION TO THE PROBLEM

Introduction

Learning to read is critical for the success of individuals and our society at large (Anderson, Hiebert, Scott, & Wilkinson, 1985). As Honig (1996) stated, "Access to further education, high-skilled jobs, and a chance to participate in the higher reaches of society depends in part on school success, which itself is highly correlated with the ability to read" (p.1). The Orton Dyslexia Society (1986) confirmed Honig's statement with the following statistics: 75% of unemployed adults, 33% of mothers receiving welfare, 85% of juveniles who appear in court, and 60% of prison inmates are illiterate. Further, Stedman and Kaestle (1987) reported that an estimated 20% of the general adult population has significant difficulties with even the most simple of reading activities.

Reading difficulties resulting in adult illiteracy often begin in early elementary school. Lyon (1995) reported that 75% of students who have reading problems that are not remediated by the end of third grade will continue to have reading problems into adulthood. This frightening statistic is bolstered by the fact that a child who is a poor reader at the end of first grade will have an 88% chance of remaining a poor reader at the end of fourth grade (Juel, 1988). Moreover, the population of elementary students at risk for reading failure is rather large. It has been estimated that in fourth grade approximately 20% of the students are reading disabled (Shaywitz, Fletcher, & Shaywitz, 1996). Because of the long-term negative effects of early reading problems and because of the importance of literacy for success in our society, the Commission on Reading (Anderson et al., 1985) emphasized the significance of reaching those at risk for reading failure as early as possible.

For decades, researchers have sought effective approaches to early reading intervention. It has been documented that instruction in phonological awareness and the alphabetic principle are essential components of early reading instruction and that students with reading disabilities typically exhibit marked weaknesses in these critical skills (Adams, 1990; Snow, Burns, & Griffin, 1998).

Stanovich (1986) defined phonological awareness (PA) as "conscious access to the phonemic level of the speech stream and some ability to cognitively manipulate representations at this level" (p.362). Instruction in PA focuses on teaching students to recognize the elements of sound and manipulate them. Specifically, teachers employ PA instruction to develop in children an awareness that words are units of speech and that syllables are parts of words. In addition, the ability to identify the beginning, medial, and ending sounds of words and the onset-rime parts of words is addressed. Instruction in the alphabetic principle, or phonics, consists of attaching the sounds of language to symbols.

Phonological awareness is often decreased in students who are at risk of reading failure (Wagner, 1986). However, researchers have concluded that, not only can PA be trained (Lundberg, Frost, & Peterson, 1988), but that such training promotes the development of beginning reading (Ball & Blachman, 1991; Cunningham, 1990). Although most at-risk students who receive PA training show substantial progress, about 25% are treatment resistant, making little or no progress either in this skill or in learning to read (Torgesen, Wagner, & Rashotte, 1997). Thus, PA instruction alone is not sufficient in enabling disabled readers to achieve reading success. Torgesen (personal communication, October 29, 1998) stated that either more intensive training in PA, or a combination of training approaches, is needed to reach a greater percentage of children with reading problems.

Direct instruction in phonics is a powerful component that should be combined with PA in the teaching of reading (Ball & Blachman, 1988; Byrne & Fielding-Barnsley, 1989, 1993; Hatcher, Hulme, & Ellis, 1994; Williams 1980). A significant amount of research exists to support the teaching of phonics for early reading success (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1989; Stanovich, 1986). Chall's (1967) extensive review of the literature revealed that researchers support the superiority of reading programs containing a phonics component. Researchers have concluded that instruction in this critical skill should be explicit, as opposed to implicit (Adams, 1990; Anderson et al., 1985).

It seems that training in PA is a prerequisite, or at least corequisite, for students' success in phonics (Ehri, 1989; Goswami & Bryant, 1990). Juel (1988) hypothesized that instruction in the alphabetic principle is ineffective unless children have some PA skills. It has been speculated that many students with reading disabilities have a deficit in phonological processing which may interfere with their ability to benefit from reading instruction (Vellutino, 1987). In fact, Liberman and Shankweiler (1985) and Wagner (1986) confirmed that poor readers often have special difficulty in processing the phonological aspects of language. We may discover that an increased emphasis in PA would enable instructors to reach the students who continue to make insufficient progress, even in a program which encompasses the instructional elements we know to be most effective for disabled readers. Torgesen (personal communication, October 29, 1998) stated that more intensive instruction in PA combined with direct instruction in phonics might facilitate the development of reading skills in disabled readers.

Rationale for the Study

While it is well-established that effective reading programs include direct, explicit instruction in PA and phonics, there are still many students who fail to learn to read, even when such instruction is provided. It has been hypothesized that more intensive instruction in PA in conjunction with strong instruction in the alphabetic principle may reduce the number of these children, who have become known as "treatment resisters." Many researchers have attempted to provide an increase in intensity in instruction in PA. This increase in intensity has typically consisted of one-to-one or small group tutoring for students who are at risk of reading failure (Lundberg et al., 1988; Schneider, Ennemoser, Roth, & Kuspert, 1999; Torgesen, Morgan, & Davis, 1992; Vellutino et al., 1996). However, this approach is often impractical in today's classrooms where financial constraints prohibit the hiring of the additional personnel needed to provide such tutoring.

Therefore, the purpose of this study was to determine the effects of increasing the intensity of instruction in PA in a regular classroom setting. Specifically, the progress of a group provided with both a Direct Instruction (DI) reading program, which incorporates explicit instruction in PA and phonics, and instruction in a structured program in PA, was compared to the progress of a group that was provided instruction in the same DI program with no additional instruction in PA, and the progress of a group that received only computer-assisted instruction in PA. The mean number of minutes each group received PA instruction during the kindergarten year was determined and compared to the mean growth of each group at the end of kindergarten in PA, phonological memory, rapid naming, and the reading of words and nonwords. In addition, sustained achievement was examined through comparison of groups at the end of the first-grade year on measures of the reading of words and nonwords, reading fluency in connected text, and reading comprehension. Finally, the group of treatment resisters was closely examined. It has been theorized in recent years that this group may have deficits in both PA and rapid automatized naming (Bowers & Wolf, 1993; Lovett, Steinbach, & Frijters, 2000; Wolf & Bowers, 1999; Wolf, Bowers, & Biddle, 2000). The students who made little or no progress in each group were examined to determine whether they did indeed fit the profile of students with a double-deficit. The data were also examined to determine whether there were students with a double-deficit who achieved at an average, or near average, level.

The Connectionist Theory maintains that learning consists of the strengthening of the connections between concepts and that these connections are strengthened through repetition or greater intensity of instruction. This study tests the premise by providing an increase in intensity in PA instruction for the experimental group. If it is shown that reading achievement can be increased and the number of treatment resisters can be reduced through the addition of a class-wide treatment, the concept of increased intensity can be made more practical and more achievable for the general classroom teacher.

Scope of the Study

When considering the generalization of the results of the study, it is important to consider delimitations and limitations. These considerations are described in the following sections.

Delimitations

The study was conducted in two elementary schools located in north central Florida. The schools were selected based on the socioeconomic status of their populations and the willingness of the principals to participate. The subjects were 105 students in 10 classes, all of whom were randomly assigned to their kindergarten classes. An interval selection method was used to select children for participation in the study. Four classes from School A were assigned to the Treatment Group, and four classes from School A were assigned to Comparison Group A. Two classes from School B were assigned to Comparison Group B. The study began in September of the kindergarten year and lasted through June of the kindergarten year. Students were tested in the fall, winter, and spring of the kindergarten year. In addition, longitudinal measures of achievement were collected in April of the first-grade year.

Limitations

The study was conducted with kindergarten children in north central Florida. Therefore, the results should not be generalized to older or younger students or to those who reside in a location with a significantly different demographic makeup. The study was further limited because the intervention occurred in a classroom setting. Normal interruptions of school scheduling occasionally prevented the delivery of the intervention, which may have proved more effective in a setting that provided for consistent delivery.

Definition of Terms

An understanding of the terms used in the study is critical to an understanding of the concepts that are discussed. The following section provides definitions of the relevant terms.

Alphabetic principle refers to the fact that symbols for letters represent the sounds of language. English is based on the alphabetic principle.

Code-emphasis or phonics programs are programs which emphasize letter-sound correspondence and specifically teach the alphabetic principle.

Direct Instruction (DI) is an explicit form of instruction which is characterized by teacher-directed, well-sequenced lessons. Teachers provide students many opportunities to respond during a lesson, accompanied by immediate corrective feedback.

Phoneme refers to the smallest discrete sound within a word.

Phonological awareness may be defined as the "conscious access to the phonemic level of the speech stream and some ability to cognitively manipulate representations at this level" (Stanovich, 1986, p. 362).

The term, phonological awareness, includes a number of specific elements. The subskills addressed in this study include phoneme blending, phoneme counting, phoneme deletion or elision, phoneme segmentation, rhyme, sound isolation, and sound matching.

Phoneme blending refers to the blending of sounds into words. For this skill, the word *man* would be presented as *m-a-n*, and the child would be asked to put the parts together to make a word.

Phoneme counting consists of counting the number of sounds, or phonemes, in a word. The word *chop* contains four letters, but only three phonemes, because the letters *ch* make one sound. Therefore, a child would identify the phonemes in *chop* as *ch-o-p*. Similarly, the word *boat* has four letters, but only three phonemes, because the letter *a* is silent. The phonemes in *boat* would be identified as *b-o-t*.

Phoneme deletion or elision entails deleting a targeted phoneme from a word. For example, if asked to say *cup* without saying *k*, the correct response would be *up*. Similarly, if asked to say *monkey* without the *k*, the correct response would be *money*.

Phoneme segmentation involves having the child repeat a normally spoken word in a segmented way. The child would be asked to produce the word *man* one sound at a time, as *m-a-n*.

Rhyme refers to the child's ability to identify words which have different onsets (the part of a word preceding the vowel) but common rimes (the rest of the word). For example, the word *mat* consists of the onset *m* and the rime *at*. Therefore, *sat*, which contains the rime *at*, rhymes with *mat*. The word *at* has no onset because no letter precedes the vowel. However, because the rime *at* is the same as that found in *mat* and *sat*, the three words rhyme.

Sound isolation consists of having the child identify the beginning, middle, or ending sounds of words. A child might be asked to identify the first sound he hears in *boat (b)* or the last sound he hears in *tree (e)*.

Sound matching involves having the child match words according to their beginning, middle, or ending sounds. The child might be asked to identify a word that starts with the same sound as *pan*. Pictures might be shown and identified as a *pig, hat,* and *cone*. The correct response would be *pig* because both *pan* and *pig* begin with a *p* sound.

Overview

The purpose of this study was to determine the effects of increasing the intensity of instruction in PA on the acquisition of literacy skills of kindergarten students. Chapter 2 presents a summary and analysis of the relevant literature. Chapter 3 describes the procedures used to conduct the study and the methods used in data analysis. Chapter 4 presents the results of the study, and Chapter 5 provides conclusions of the study, implications for educators, and recommendations for further research.

CHAPTER 2
REVIEW OF RELATED LITERATURE

Introduction

Chapter 2 provides a conceptual and theoretical background for an investigation into the effect of intensity of instruction in phonological awareness for emergent readers. A review and analysis of the literature on the relationship between phonological awareness and reading, the efficacy of combining instructional components, and the implications for increasing the intensity of instruction are presented.

The chapter is divided into several sections. The first section presents a conceptual and theoretical background for reading acquisition. The concept of Connectionism is discussed, and several prominent models of reading acquisition, which are based on this concept, are provided. The second section provides a conceptual background for instruction in PA. Subsequent sections present a discussion of the relationship between PA and reading, an examination of the efficacy of combining instruction in PA with instruction in the alphabetic principle, and describe essential components of such instruction. The final sections address the problem of treatment resisters, the effect of intensity of instruction in decreasing numbers of treatment resisters, and the practicality of increasing intensity in a regular classroom setting. Finally, the implications of the findings for this study are addressed.

Conceptual and Theoretical Background for Reading Acquisition

In understanding the process of reading acquisition, it is important to understand the conceptual background upon which current reading models are based. The Connectionist Theory, as explained by McClelland, Rumelhart, and Hinton (1986) and Bereiter (1991), provides a framework for these models. Seidenberg and McClelland's model (1989), which uses Connectionism to explain the process of word recognition, is examined. Adams' (1990) frequently cited model, which expands the work of Seidenberg and McClelland, and attempts to describe the complete reading process, is also reviewed. Finally, Ehri's model (1991), which places emphasis on phonological processing, is discussed.

Connectionist Theory

The Connectionist Theory may be understood by examining the Parallel Distributed Processing model of McClelland et al. (1986). According to the theory, units interact by sending excitatory and inhibitory signals to each other. A strengthening of the connections between units in a network represents learning. In this model, knowledge is in the connections between units, not the units themselves. The units represent specific concepts such as phonology or orthography. The connections between units are constantly changing and can be strengthened through experience. According to the theory, the application of rules, rather than the memorization of rules, is an essential part of learning.

Bereiter (1991) constructed a physical analogy to help explain how learning could take place without rules. In his analogy, frisbees are connected with rubber bands to each other and to the walls of a room. The frisbees clamped to the walls pull on the frisbees to which they are attached, which in turn pull on other frisbees. The rubber bands are thought of as a "network of constraints" on the frisbees, which limits the positions they may assume. The frisbees with the most attachments to other frisbees are pulled high off the floor and represent a strong "pattern of activation," while those with few, or weak, attachments hang limply or remain lying on the floor. Figure 1 demonstates Bereiter's concept of Connectionism. In Figure 1, the activated units form the letter *A*, while the hidden units, which are transparent, are essential to the output pattern. The unactivated units sag below the level of output. Instruction results in a strengthening of the connections which, when activated, result in a different output. Bereiter asserted that it might take tens of thousands of repetitions for the frisbee network to recognize the 26 input patterns in the alphabet. These repetitions strengthen the connections and allow activation to take place without knowledge of rules. We might think of an increase in repetitions as a higher level of intensity of instruction. Therefore, increasing the intensity of instruction should result in stronger connections and a more accurate output.

Seidenberg and McClelland's Model of Word Recognition and Pronunciation

The model presented by Seidenberg and McClelland (1989) forms the basis for much of our present-day understanding of the reading process. The model was based largely on work by Seidenberg, McClelland, and Rumelhart (Rumelhart & McClelland, 1986a; Rumelhart & McClelland,

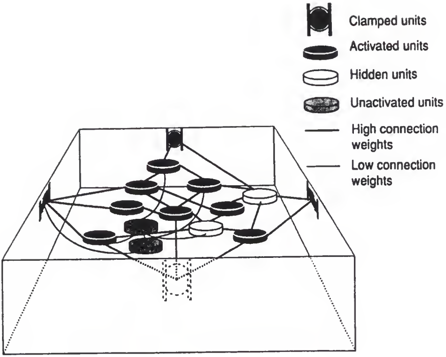

Figure 1. Bereiter's Model of Connectionism (Bereiter, 1991, p. 12)

1986b; Seidenberg, 1985). Seidenberg and McClelland described their model of word recognition and pronunciation in 1989. They based their model on the Connectionist Theory, which they described as well-suited to accounting for growth in word recognition, as experience serves to modify and strengthen the connections between units in the memory network.

The model, represented in Figure 2, emphasizes the orthographic and phonological levels. These levels give information to hidden units that collect stimulus from both

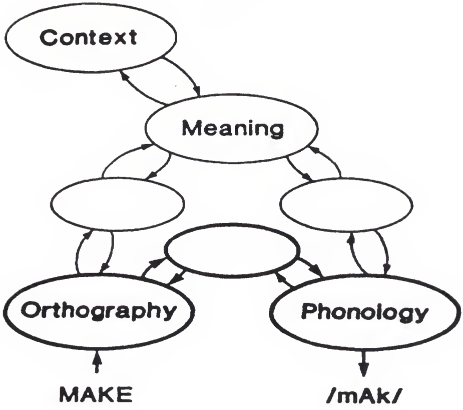

Figure 2. Seidenberg and McClelland's Model of Word Recognition and Pronunciation (Seidenberg & McClelland, 1989, p. 526)

the orthographic and phonological levels. The feedback from the hidden units to the orthographic level represents word-to-letter connections. Feedback from the phonological to hidden units is not considered, which means that, in this model, the phonological level does not influence the representations which are constructed at the orthographic level.

The hidden units receive input from the orthographic units and send excitatory and inhibitory signals to both the orthographic and phonological units. These two output patterns are compared to the target patterns which should have been produced by the model. The orthographic pattern is merely the orthographic input pattern, while the phonological pattern may be generated from the child's own pronunciation of previously learned sounds or words or from the teacher's pronunciation of sounds or words.

The input from the orthographic unit is computed by considering the weight of the connection between the hidden and orthographic unit as well as an extra weight called *bias*. The strength of the pattern of signals that is sent to the phonological and orthographic units is determined by previous learning that has occurred as a result of exposure to letter and phoneme strings. Instruction adjusts the strengths of the connections in the network and results in a reduction of error.

Seidenberg and McClelland (1989) stated that their model applied only to monosyllables and that only the orthographic and phonological processors were implemented in their model of word recognition and naming.

Adams' Model of the Reading Process

Adams (1990) expanded Seidenberg and McClelland's (1989) model of word recognition and pronunciation to include the entire reading process. The model developed by Adams, represented in Figure 3, includes four processors: orthographic, phonological, meaning, and context.

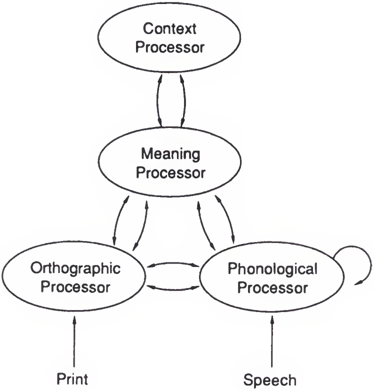

Figure 3. Adams' Model of the Reading Process (Adams, 1990, p. 158)

In Adams' expanded model, the orthographic processor perceives letters in sequence from the printed page and the phonological processor maps these letters onto their spoken equivalents. The meaning processor contains our knowledge of word meanings, and the context processor constructs an ongoing understanding of the text.

Adams asserted that the processors do not act, or develop, in isolation. They act simultaneously, continuously sending information to, and receiving information from, each other. They develop in concert also, growing to and from each other. For the connections between the processors to develop properly, they must be linked even in the course of acquisition.

Each processor in Adams' model contains many small, interconnected units that instantly merge to provide the reader with information. For instance, in the orthographic processor, shapes merge to form letters that merge to form words. These letters and words correspond to meaning units as well as to elementary speech sounds.

As each processor sends energy to, and receives energy from, the other processors, the skilled reader simultaneously recognizes the spelling, sound, and meaning of a familiar word, leaving the attention free to focus on reflective thought.

The orthographic processor. The orthographic processor is the only processor that receives information directly from the printed text. Skilled reader's eyes leapfrog from word to word, stopping briefly at the center of each word, taking in every letter of the word. Through multiple exposures to print, the reader develops learned associations between individual letters. The learned associations are responsible for skilled readers' rapid, holistic response to familiar words. The interletter associations are also responsible for processing letter order and breaking words into syllables.

Skilled readers process familiar letter orders rapidly and rarely make mistakes in the order. Conversely, poor readers often make mistakes. Adams (1979) demonstrated that, when faced with orthographically irregular words, skilled readers make as many ordering mistakes as poor readers, leading to the conclusion that the rapid, correct, order production is due to an overlearning of expected letter order.

Poor readers also have difficulty breaking words into syllables, whereas skilled readers do so rapidly and efficiently. Again, it is an overlearned knowledge about likely and unlikely letter order that allows skilled readers to do so. Interletter associations that occur frequently in print have strong connections, whereas those that rarely occur have weak connections. The skilled reader automatically breaks words into syllables at the weakest links.

The orthographic processor transmits a perceived letter string directly to the phonological and the meaning processors. If the word is pronounceable, the phonological processor sends information back, while the meaning processor returns information about the word's meaning. At the same time, the phonological and meaning processor exchange information with each other regarding the word's pronunciation and meaning.

The phonological processor. Like the orthographic processor, the phonological processor accepts information from the outside: It receives information from speech. The phonological processor contains a complex array of sound units that correspond to the auditory images of phonemes, syllables, and words. The phonological translations that result help provide a backup system for visually unfamiliar words. As the reader translates spelling patterns into sound, the word's pronunciation is produced and helps to lead to its meaning. Even though skilled readers do not depend on the phonological translation of familiar words, they seem to produce them anyway. This critical duplication of information leads to fluency and comprehension.

Adams (California State University, 2000) identified three areas of phonological processing that predispose children to learning difficulties: phonological awareness, lexical access, and phonological memory. Of these, phonological awareness poses the greatest threat to reading success. It is here that the reading process most often breaks down for children who struggle to learn to read. Problems in hearing the sounds of language make it difficult to map letters and words to their spoken equivalents and difficult to blend the sounds to produce words.

The meaning processor. Meaning is represented in the meaning processor as interassociated sets of primitive meaning units. These units help a reader determine the meaning of a word. If the word is familiar, the meaning of the letter string accepted from the orthographic processor and the spoken equivalent accepted from the phonological processor will be instantly recognized. If not, the meaning units that are activated help to create an expectancy of the word's meaning. Although the likelihood of a child learning the meaning of a new word in context in the first encounter is only 5% to 20% (Nagy, Herman, & Anderson, 1985), each subsequent encounter of the word helps to form an overlap of old and new meaning units, which help to construct the definition of the word.

The context processor. The context processor is responsible for creating an ongoing interpretation of the text by sending information to, and receiving information from, the meaning processor. The context processor works by selecting word meanings that are appropriate for the text. Though the processor stimulates the reader's awareness of appropriate words and meanings, it does not prevent stimulation of inappropriate ones.

Context, for good readers, does not have an effect until after the word is identified. Skillful readers do not use context to take the place of orthographic information but rather to speed and assist in the interpretation of such information. Poor readers, on the other hand, frequently use context clues to decipher words (Stanovich, 1980).

For poor readers, an underexposure to text may hinder the operation of the context processor, as it does in other processors. Poor readers have had less opportunity to strengthen the components of the processor and the connections between processors.

Ehri's Model of the Word-Reading Process

Though Ehri's model addresses only the word-reading process, it is important because it emphasizes phonological processing, as did Adams' model. Ehri (1991) reported that the choice of terms for describing her model originated with Firth (1985) and are as follows: logographic, alphabetic, and orthographic.

Logographic phase. Ehri asserted that, in the logographic phase, students use strictly visual clues to read words. Logographic writing systems use visual symbols to represent words, as in Chinese. In contrast, English, an alphabetic writing system, uses letters which correspond to sounds to represent words. Readers who are in the logographic phase might remember a word by its shape or by using other visual cues. Readers in this phase face difficulties in remembering the arbitrary associations formed between visual clues and words. Often these readers have not mastered letters or sounds, in contrast to alphabetic readers, who rely on letter-sound associations.

Transitional alphabetic phase. It is difficult to determine when readers begin to enter the alphabetic phase. They pass through a transitional phase when they begin to use letters as symbols representing sounds rather than just as visual cues. In this phase, readers begin the process of phonological recoding, though they may only use the beginning sound of a word to interpret its orthographic representation. Phonemic awareness begins to play an important role in this phase of learning as the reader begins to activate the phonological processes. Ehri described this early phase of alphabetic reading as phonetic cue reading, in contrast to the visual cue reading that occurred initially (Ehri, 1987, 1989). Unlike the arbitrary access routes of the logographic phase, the alphabetic routes are systematic, which make them easier to remember. Beginning alphabetic readers, like logographic readers, read most words by sight. They differ from logographic readers, however, in their use of letter-sound information to remember the words they read.

Alphabetic phase. As readers enter the alphabetic phase, they become able to recode orthographic representations into pronunciations according to grapheme-phoneme rules. They are able to read unfamiliar words and are able to read sight words with increased accuracy. Initially, blending phonemes to form words is a laborious process but improves with practice. The rules taught in phonics instruction are thought to help beginning readers internalize the application of the rules so that artificial application of rules is abandoned. Ehri (1991) noted that explicit synthetic phonics instruction is more effective than implicit phonics instruction in helping readers move to the alphabetic phase and helps them become more proficient at phonological recoding. She also observed that skill in phonemic segmentation can be taught and helps students become more able readers.

Ehri (1991) maintained that sight word reading is heavily dependent on phonological processing. She stated that the first time a word is read, it is read by phonological recoding. Each time the word is read again, access routes, which are dependent on letter-sound correspondences, are strengthened. Eventually, phonological rules are no longer required to convert the orthographic representation to pronunciation and access its meaning. This type of sight word reading is fundamentally different from logographic sight word meaning, as spellings, which are linked to the phonological structure of words, form its basis.

In Ehri's model, those with a phonological deficit would have difficulty at both the transitional alphabetic and alphabetic phases, as their difficulty in hearing the sounds of language would result in difficulty in mapping orthographic representations to their phonological representations. This, in turn, would make a transition to the orthographic phase difficult.

Orthographic phase. Readers must become proficient at the alphabetic stage of reading to be skilled at the orthographic phase. In this phase, students begin to remember spelling patterns as wholes and use these groups of letters to decode unfamiliar words. This skill facilitates, and makes more fluent, the decoding of new or unfamiliar words by sight. Older readers are more likely to read words using this analogy strategy than are younger readers. For readers to use this strategy, they must be able to segment words into the onset and rime components and must have skill in phonological recoding.

Because phonological processing plays such a major role in Adams's and Ehri's models, it is worthy to consider this important element in more detail.

Conceptual and Theoretical Background for Instruction in Phonological Awareness

The emphasis on the sounds of language as an important element in the instruction of reading began with a reading program developed by K. D. Ushinsky (cited in Downing, 1973). Ushinsky's analytic-synthetic method of phonics instruction was used in the Russian school system over 100 years ago and placed more emphasis on the auditory aspects of reading instruction than it did on the visual aspects. Ushinsky maintained that it is the auditory processes, not the visual processes, that allow the reader to create the sound of a word. Ushinsky asserted that the sound structure of language must be understood by the beginning reader and must precede the learning of the orthographic representations.

Two Russian psychologists, following in Ushinsky's footsteps, revived the interest in the auditory aspects of reading in the 1960s. Zhurova (1963) discovered that infants can distinguish sound complexes by the age of 2 but that preschoolers have difficulty distinguishing phonemes. This led to the supposition that speech acquisition comes naturally, while the identification of phonemes in words must be taught. Elkonin (1963) developed a method to teach children to isolate and identify individual phonemes. He represented phonemes with markers which children moved to demonstrate the number of sounds in a word. The children were taught to pronounce a word slowly and to move a marker as each sound in the word was pronounced. The markers were gradually replaced by letters as children gained facility with the system. By 1973, Elkonin claimed that children using his method improved in their acquisition of literacy.

Since that time, many researchers have investigated the role of PA in the acquisition of reading.

Relationship Between Phonological Awareness and Reading

Since Elkonin's seminal research, much evidence has accumulated which indicates that PA is critical in the acquisition of reading. Torgesen and Mathes (1999) categorized the research findings as follows: "(a) differences in PA predict subsequent growth in reading ability . . .; (b) poor PA is a reliable diagnostic sign of serious reading disability . . . ; and (c) instruction in PA accelerates reading growth" (pp. 4-6).

Differences in PA Predict Subsequent Growth in Reading Ability

Blachman (1984) sought to predict reading achievement by measuring language analysis skills and rapid naming speed in 46 kindergarteners and 48 first graders. She concluded that, in kindergarten, rapid naming of colors was significantly related to five of six measures of reading achievement, while rapid naming of objects, syllable segmentation, and rhyme production were significantly related to at least three of six. In first grade, rapid naming of letters and phonemic segmentation were significantly related to all three measures of reading achievement examined.

A similar study was designed by Mann and Liberman (1984) to determine the best predictors of reading success. Sixty-two kindergarten children were tested using three tests: syllable counting, word-string memory, and Corsi block. In this study, the ability to segment words into syllables was determined to be the most accurate predictor of first-grade reading success. Students who did well in repeating word-strings also were more likely to become good readers in first grade than were students who had difficulty with this verbal memory task. The block task, in which the student was asked to tap blocks in the same order as the examiner, seemed unrelated to future reading success.

Bradley and Bryant (1983) also found results that indicated the importance of PA in predicting future reading success. They followed a group of 400 children for a period of 4 years and found that the ability to identify the odd word out of four words, such as *bun, gun, hut, sun,* strongly predicted subsequent success in reading but not success in mathematics.

A longitudinal study conducted by Torgesen, Wagner, and Rashotte (1994) supported the previous conclusions.

They followed 244 children from K through 5th grade. The following phonological variables were measured: synthesis, analysis, memory, serial naming, and isolated naming. When the relationship between each phonological variable and first-grade word-reading skill was examined, they found that each phonological variable had a significant correlation to word-reading. The relationship between the phonological variables and second-grade reading was similar, with the exception that synthesis had a stronger correlation than analysis. Of the phonological skills tested, phonological awareness had the strongest relationship with future reading achievement. They found that children who scored below the 20th percentile in PA, performed, on average, 2 years below grade level in sight word reading and 3 years below grade level in comprehension in 5th grade.

Further evidence for the statement that difference in PA abilities predict subsequent reading achievement comes from a study by Bryant, MacLean, Bradley, and Crossland (1990). In a 2-year study involving 64 children, PA tasks were administered four times: the first when the children were an average of 4 years 7 months old and the last when the children were an average of 5 years 7 months old. The first two assessments included tasks of rhyme and alliteration. The last two included tasks of phoneme detection. Outcome measures of reading, spelling, and arithmetic were administered at 6 years 7 months. Bryant et al. (1990) concluded that an early awareness of rhyme leads to an awareness of phonemes about a year later and that phoneme awareness is strongly related to reading but not to arithmetic.

A study conducted by Foorman and Francis (1994) supports the connections between phonemic segmentation abilities, reading, and spelling. Phonemic segmentation ability of four first graders was assessed through the use of a test requiring the deletion of initial, medial, and final sounds. Analysis indicated that lack of growth in phonemic segmentation skill was correlated with inadequate progress in reading and spelling.

Poor PA is a Reliable Source of Serious Reading Disability

It follows that, if differences in PA predict subsequent growth in reading ability, deficiencies in phonological awareness might be a contributing cause of reading disabilities. The following studies support this view.

Stanovich and Siegel, in a 1994 study, compared disabled readers with and without discrepancies between their achievement and IQ and found no difference in the groups in phonological and orthographic processing. They further found that disabled readers, when age-adjusted for decoding, were deficient in phonological processing but more skilled in orthographic processing. This led Stanovich and Siegel (1994) to suppose that the students' relative strengths in orthographic processing helped to compensate for their weaknesses in phonological processing. However, these ability differences faded when the reading-level match was based on performance rather than age, and the deficiencies in both processing areas reemerged. Stanovich and Siegel concluded that their study supports the concept that reading disabilities are due to a phonological-core deficit and that the degree of aptitude/achievement discrepancy is unrelated to the cognitive trade-offs which were observed.

Morris et al. (1998) supported this phonological-core variable-difference model. Their study involved 232 children who were assessed on eight measures of cognitive and language functions. Multiple methods of cluster analysis were used in an effort to identify subtypes of reading disability. Seven subtypes emerged from the data, and six of the seven subtypes showed deficits in phonological processing but varied in the extent of their impairment in other cognitive and language skills. The seventh subtype showed deficits in a number of verbal and nonverbal measures associated with rate of processing.

This observation is further supported by a study conducted by Fletcher et al. (1994). They compared nine cognitive variables, related to reading proficiency, for 199 children, 7.5 to 9.5 years old. Children with reading difficulties, whether or not they demonstrated an IQ-based discrepancy, were found to be consistently more impaired in PA than any other single disability (of the many verbal/ nonverbal measures taken).

Work at the Yale Center for the Study of Learning and Attention supports the view that deficits in phonological processing lead to difficulties in reading. Shaywitz (1996) reported that 200 dyslexic and nondyslexic children and adults were studied using functional magnetic resonance imaging (fMRI). The fMRI allows researchers to observe the metabolic activity of the brain while a subject is involved in a cognitive task, such as reading. The tests showed that the identification of letters, phonological processing, and access to meaning occur in distinctly different areas of the brain. Observations have shown, through yearly monitoring of phonological skills from 1st through 12th grades, that phonological deficits, and corresponding difficulties in reading, continue well into adulthood.

Instruction in PA Accelerates Reading Growth

If deficits in phonological processing indicate probable future difficulties in reading, it is essential that we explore types of effective training in PA. The intensity of training required in kindergarten, to prevent future reading disabilities, must be explored and identified.

Torgesen et al. (1992) examined the effects of different types of training on 48 kindergarten children who participated in small-group sessions 3 times per week for 7 to 8 weeks. One training group was taught blending skills, while the other was taught blending and segmenting skills. The results were compared to those of a control group who received no phonological awareness training. Torgesen et al. found that the group taught blending and segmenting outperformed both the other treatment group and the control group on segmenting tasks, while the group that was taught blending alone failed to generalize this treatment in a significant way when compared to the other two groups. Torgesen et al. maintained that this study gives evidence for the efficacy of training in both synthesis and analysis tasks.

Lundberg et al. (1988) conducted a longitudinal study in which 400 Danish preschool children were followed through second grade. The 235 children in the experimental group received training 15 to 20 minutes per day for 8 months in listening games that progressed to rhyming, blending, and segmentation activities. The evidence indicated that phonological awareness can be developed before, and independently of, reading ability. The evidence further indicated that the training had a selective effect: It did not improve general language comprehension skills and did not seem to affect the tendency to learn letters informally. It did, however, affect metaphonological skills, particularly those requiring the manipulation of phonemes. There were marginally significant differences in reading and spelling scores for the experimental and control groups in grade 1 but stronger effects in grade 2, which indicates that the training had a lasting effect on the acquisition of reading skills. However, there were still children who showed no improvement in metaphonological skills, even though a variety of training activities were included. For example, 6% of the experimental group showed no phonemic segmentation ability after training versus 37% of the control group.

Schneider et al. (1999) further explored training effects on various groups of children. A total of 191 German kindergarteners served as the experimental group, while 155 kindergarteners comprised the control group. Both groups were pretested and posttested on various tests of phonological awareness. The treatment group participated in daily phonological awareness training sessions of 10 to 15 minutes for a period of 6 months. At the end of the training period the treatment group significantly outperformed the control group on measures of phonological awareness, reading, and spelling. One result of note is that the children in the experimental group who were identified at-risk from the pretest results significantly outperformed the control group on posttests of reading and spelling over the first 2 school years. However, Schneider et al. reported that there were children in the treatment group who did not benefit from the training program.

Vellutino et al. (1996) conducted a longitudinal study that followed a large group of children from kindergarten through fourth grade to determine how well different groups of students responded to remediation. All kindergarteners were given a large battery of psychological tests. In mid-first grade a sample of normal and poor readers were selected from the kindergarten group. One hundred eighteen children, who scored below the 15th percentile on reading measures, were identified as "poor readers," while 65 children, who scored at or above the 40th percentile on the same reading measures, were identified as "normal readers." The poor readers were randomly divided into a tutored group and a nontutored group. Children in the tutorial group were tutored for 30 minutes per day for one to two semesters. Tutoring consisted of reading connected text and of practice in PA, sight word recognition, and writing. All children were administered individual achievement tests through fourth grade and cognitive ability tests in first and third grades. Vellutino et al. found that 67% of poor readers who received one-to-one tutoring scored in the average or above-average range after only one semester of tutoring. However, 33% scored below the average range, and 15% scored below the 15th percentile. It is noteworthy that children who were difficult to remediate scored below those who were readily remediated on kindergarten and first-grade tests evaluating phonological skills but not on those evaluating semantic, syntactic, or visual skills.

Combination of Instructional Components

Having determined that instruction in phonological processing is beneficial for most students, it is important to remember that researchers have indicated that this instruction should be combined with instruction in the alphabetic principle.

Combining Phonemic Awareness and Phonics

A program which combined explicit training in phoneme analysis and blending, with letter-sound correspondences and decoding, was investigated by Williams (1980). All students in the study were enrolled in classrooms for students with learning disabilities and were between the ages of 7 and 12. Sixty-three children were chosen to participate in the study and were organized in groups of three to five students. The author stated that the four children from each classroom who were expected to "benefit most" were selected. Teachers used the program 20 minutes a day for approximately 26 weeks. Syllable analysis and synthesis was followed by phoneme analysis and synthesis. Then letter-sound correspondences were taught for the phonemes previously introduced, and manipulative letters were used to decode and spell words. Finally, new letter-sound correspondences were introduced, and the manipulative letters were used to decode and spell words with specified spelling patterns. After each decoding/spelling session, the practiced words were used in meaningful and nonsense sentences, and simple comprehension activities were practiced. Results indicated that the children in the treatment group performed significantly better than the control group on decoding tasks, both on familiar and novel words. Williams reported that her study supports a combination of phonemic awareness and decoding strategies in classroom instruction.

This assertion is supported in a five-part 1989 study by Byrne and Fielding-Barnsley. In Experiment 1, 19 preschoolers, who were screened for letter and word knowledge, were chosen for the study. Only 10 of the children reached criteria (the learning and correct transfer of word part/symbol associations) on the first 2 days of the study and remained for the third day of training. On the third day, students were asked to learn and to transfer phoneme/symbol associations. The transfer performance for compound words and nonsense words was high, but not for phonemes. The researchers concluded that an unfamiliarity with phonemic structure formed a barrier for the students, rather than an inability to connect speech to symbols.

In Experiment 2, 12 preschoolers were first taught to segment words and then taught to "read" symbols which were to represent two words. Only the children who could segment words, identify words with the same onset sound, and could identify symbols for the letter sounds could transfer this ability to read new "words." This led Byrne and Fielding-Barnsley (1989) to conclude that both phonemic awareness and knowledge of letter-sound correspondences are necessary for successful understanding of the alphabetic principle.

For Experiment 3, 30 preschool children were randomly assigned to one of three groups. One group replicated Experiment 2, one group received only training in segmentation, and one group received only training in identifying initial sounds. Again, Byrne and Fielding-Barnsley (1989) found that only children who were successful in phonemic segmentation, in matching initial sounds, and in identifying letter-sound correspondences could transfer this knowledge to new "words."

Experiment 4 replicated Experiment 2, except that actual letters were used rather than symbols in teaching letter-sound correspondences. The 11 preschoolers involved had no previous letter knowledge. Only four children demonstrated knowledge of segmentation and onset identity and consequently demonstrated successful word learning. The results of this experiment confirmed Byrne and Fielding-Barnsley's (1989) conclusions from Experiments 2 and 3 and led to the conclusion that the statements made previously about the alphabetic principle apply when the English alphabet is used. In addition, they found that six children could segment, but only four could identify matching onsets. None who could identify matching onsets failed to segment, which led to the supposition that the two aspects of phonemic awareness may be interdependent.

Experiment 5 attempted to discover if the students who had successfully performed on all phases of Experiments 3 and 4 could replicate their success if the phoneme-matching phase involved phonemes other those which were onset. Eleven students were involved in this phase of the study. Students from Experiment 3 worked with geometric symbols for letter sounds, as they had initially, and students from Experiment 4 worked with regular alphabetic symbols. Eight of the 11 children performed successfully on the transfer task when the phoneme was moved to the final position. Byrne and Fielding-Barnsley (1989) concluded that some children readily transfer their phoneme-matching knowledge, regardless of where the phoneme occurs in the word, whereas for others, that knowledge may be position-specific.

Another study by Byrne and Fielding-Barnsley (1993) followed Australian preschoolers through the end of first grade. The researchers reported evidence of the important contribution made by both phonemic awareness and knowledge of the alphabetic principle in acquisition of reading and spelling skills. Sixty-four preschoolers were trained to identify items which began or ended with the same sound. They were trained in groups of four to six, 30 minutes per week, for 12 weeks. All but 3 of the 64 children in the treatment group showed substantial gains in phonemic awareness, compared to the modest gains of the 62 children in the control group. Most children in the treatment group showed an ability to generalize the concept of phoneme identity to sounds that were not part of the training program. Children in both the experimental and control groups who entered school with an understanding that words can share sounds scored higher on tests of the reading of real and pseudowords, and on tests of spelling, than children who did not, with the greatest effect noticed on the reading of pseudowords and on spelling. In the initial analysis, the researchers found substantial correlations between alphabet knowledge and word reading, nonword reading, and spelling. By conducting multiple regression analyses, they found that phoneme identity contributed significantly to the variance in nonword reading and spelling but not for word reading. They attributed the lack of contribution to word reading as an indication that at an early age, word reading, but not nonword reading, may be rote. Byrne and Fielding-Barnsley concluded that their data revealed that knowledge of letter-sound relationships was highly correlated with early literacy development and that their study demonstrated the advantages of combining classroom instruction in both phonemic awareness and letter knowledge.

Hatcher et al. (1994) agreed that phonemic awareness training is most effective when combined with training in letter-sound practice. Their study, involving 124 seven-year-olds from the United Kingdom, compared three experimental groups with a control group. The first experimental group was instructed in PA with letter-sound practice within the context of reading; the second was instructed in reading with letter-sound practice but no PA instruction; and the third was instructed in PA only, with no letter-sound practice and no reading instruction. The study involved 40 thirty-minute sessions over 25 weeks. The students who received a combination of PA and letter-sound instruction in the context of reading performed significantly better in a reading and in spelling than did the other groups. Nine months later reading gains were shown to be stable, but spelling gains were reduced.

The results of Hatcher et al. (1994) are supported in a study by Ball and Blachman (1988, 1991). Ninety kindergarten students were randomly assigned to a treatment group or one of two control groups. The treatment group learned letter-sound correspondences and learned to segment words into one to three phonemes. The first control group listened to stories and learned the same letter-sound correspondences as the treatment group, while the second control group received no intervention. The first two groups met for instruction in small groups, 15 to 20 minutes a day, 4 days a week, for 7 weeks. Upon analysis, it was found that the treatment group outperformed both other groups on measures of phonemic segmentation, spelling, and reading.

The Reciprocal Nature of the Development of PA and Decoding Skills

As has been demonstrated (Ball & Blachman, 1988, 1991; Byrne & Fielding-Barnsley, 1989, 1990, 1991, 1993; Williams, 1980) instruction in both phonemic awareness and the alphabetic principle is required for many children to develop successful literacy skills. Extensive research (Blachman, 1987; Bradley & Bryant, 1983; Clay, 1979, 1985;

Wallach & Wallach, 1977; Williams, 1980) has shown that the most significant effects on reading achievement have resulted from programs that emphasize phonemic segmentation and blending along with letter-sound instruction. Researchers (Ehri, 1989; Goswami & Bryant, 1990) have also indicated that more difficult segmentation skills, such as elision, are developed as skill in word decoding increases. It is evident that phonemic awareness and alphabetic decoding skills develop, at least to some degree, in tandem and that the skills are mutually facilitative.

This supposition is supported by Perfetti, Beck, Bell, and Hughes (1987) in a longitudinal study of 82 first-grade children. The subjects included one group that received reading instruction through a systematic, direct code program and two groups taught reading through basal reader systems, one at a readiness level that progressed to a first reader level and the other at a first reader level. Neither of the basal groups were instructed in phonics. The direct code program taught blending and letter-sound correspondences. Tests were administered four times during the school year. A synthesis test required that students blend segments to produce a word or pseudoword. All direct code students eventually achieved criterion on this task. In comparison, 12% of the first reader students and 29% of the readiness students failed to achieve criterion by the end of the school year on the synthesis task. On a tapping task, which required that students tap a pencil for each sound heard in a word, few children achieved criterion, though scores were higher for children in the direct code group and the first reader group than for the readiness group. The authors attributed this finding to the fact that emerging spelling strategies seemed to guide the students' responses. A deletion task required that the student delete an initial or final phoneme. By the end of the year, about half of the children had reached criterion on this task. Most of the direct code and first reader students successfully performed this task, though only 26% of the readiness group exceeded the 75% criteria. During the last three testing times, a measure of pseudoword reading was administered, and at the end of the year, two measures of reading achievement were collected. The authors concluded that success on the synthesis task seemed to enable reading achievement, although the reading achievement results for students in the basal program were more dependent on analysis and synthesis, than were the results for the students in the direct code group. For deletion alone, the results were mixed. For both basal groups, pseudoword performance predicted later deletion performance, which predicted even later reading ability. For the direct code group, there was no point at which deletion predicted future reading achievement. When groups were considered as a whole, Perfetti et al. concluded that phonemic awareness and learning to read developed "in mutual support." They proposed that some ability to manipulate sound segments might be necessary for beginning reading and that the reading process itself teaches the child to manipulate segments of speech.

Peterson and Haines (1992) reached a similar conclusion in a study which focused on training in phonemic segmentation. They noticed a differentiated effect for low-, middle-, and high-scoring segmenters. In a 1-month period, children were trained to segment words into the onset and rime sections and then asked to read additional words by analogy. These additional words consisted of rhyming words. The child was to apply the rime pattern in reading the new words. Low segmenters failed to improve their ability to read words by analogy, although they did improve their ability to segment words. They also made a small but significant gain in letter-sound knowledge. The middle segmenters showed the greatest gain in analogy reading, followed closely by the high segmenters. Both groups demonstrated gains in the segmentation tasks and in letter-sound knowledge, though the gains for the latter were moderated by a ceiling effect. The results suggest that word segmentation and analogy reading may be hierarchal tasks.

Essential Components of Successful Phonics Programs

If instruction in PA is to be delivered in tandem with instruction in phonics, it is essential to examine the elements which must be included in successful phonics programs. Grossen and Carnine (1993), after reviewing the literature, described several important aspects of a successful reading program. First, they stated that letter-sound correspondences should be taught in isolation, systematically and explicitly. Reading passages which correspond with the phonic generalizations that have been taught should be used. The most frequent letter-sound correspondences should be taught first. Second, students should be taught to blend sounds to make words. The students should begin blending instruction as soon as they know two sounds which can be blended to make a word. Third, the students should receive immediate error correction in the form of oral feedback. Students should read orally so that errors can be detected and corrected immediately. Grossen and Carnine stated that, when corrective feedback is provided after every error, students make fewer errors overall. Fourth, extensive practice should be provided. It is urged that this practice involve the application of sounds the children have recently learned in the reading program.

Letter-Sound Correspondences Should Be Taught Explicitly

There are essentially two approaches to the teaching of phonics: explicit and implicit. In explicit phonics instruction, also known as synthetic phonics, students are taught the sounds of letters and then taught to blend these sounds to make words. In implicit, or analytic, phonics instruction students are not taught the sounds of letters in isolation. Rather, they are taught to recognize sounds as they appear in words. They may, for instance, be asked to determine the sound a group of words has in common and then be taught the name of the letter which makes the common sound.

Grossen and Carnine's (1993) first component, which calls for the explicit teaching of phonics, is supported in research reported by Foorman, Francis, Beeler, Winikates, and Fletcher (1997). Second and third graders, identified as learning disabled through use of an IQ-achievement discrepancy model, were targeted for the study. One hundred thirteen students participated in the study for at least 6 months of intervention. Students were taught through either a synthetic phonics method, a combination of synthetic and analytic phonics methods, or a whole word method. The growth of students in phonological synthesis and analysis, orthographic processing, and word reading was assessed four times during the year. The synthetic phonics group outperformed the other two groups in phonological processing and in word reading, while the synthetic phonics outperformed the synthetic/analytic group but not the whole word group in word reading. This supports the previous statement (Grossen & Carnine, 1993) that phonics instruction should be explicit and that individual sounds should be isolated when initially introduced.

Blending Should Be Taught

Grossen and Carnine's (1993) second component, that blending should be taught explicitly, is supported by a study by Foorman et al. (1997). Three hundred seventy-five first- and second-grade students receiving Title I services were followed for 1 year. Students received instruction in a Direct Instruction (DI) program, an embedded phonics program, or a whole language program. In the DI program, which specifically emphasized blending, 8 to 10 words were blended daily. Both the DI program and the embedded phonics program taught word analysis, and all three groups had spelling, writing, and read-aloud components. In addition, students received 30 minutes of intervention instruction daily in a tutorial. The DI tutorial was modeled after the DI program, while the embedded phonics and whole-language tutorials were modeled after the Reading Recovery program. Again, only the DI tutorial focused explicitly on blending as a key strategy for applying the alphabetic principle. On average, the DI students improved at a faster rate and had higher end-of-year scores than did students in the other two groups on word reading, phonological processing, and spelling. Overall, the classroom DI program brought Title I students close to the national average in reading, while Title I students in the whole language classrooms performed near the 25th percentile.

Corrective Feedback Should Be Provided

Grossen and Carnine (1993) also maintained that corrective feedback should be provided. This statement is supported in a study conducted by Kline, Schumaker, and Deshler (1991) in which feedback methods were studied. Eighteen teachers and their students participated in the study which indicated that students who received corrective feedback reached mastery in approximately two-thirds the time required by the comparison group. The researchers concluded that teachers need to be trained in analyzing and correcting student errors and confirmed the use of corrective feedback as a valuable instructional tool.

Findings from a 1988 study by Pany and McCoy also support the effectiveness of corrective feedback. Sixteen students who scored between the 10th and 35th percentiles on a reading achievement test received error correction for all oral reading errors, correction for only those errors which involved meaning change, or no error correction. The researchers found that corrective feedback on all errors had a significant positive effect on both word recognition errors and reading comprehension.

Perkins (1988) found a significant difference in types of feedback. In a study involving 48 elementary school subjects who were randomly assigned to four treatment groups, Perkins examined the effect of types of feedback on the acquisition of decoding skills. She found that any type of feedback was superior to no feedback and that corrective feedback, in which error-corrections were modeled and words were sounded out, was superior to general feedback. Perkins further found that modeling must be combined with instruction in word attack to produce lasting results.

Extensive Practice Should Be Provided

A 1990 study conducted by Brown and Felton as part of the Bowman Gray Learning Disabilities Project, supported Grossen and Carnine's (1993) statement that extensive practice should be provided. A group of 48 kindergarten children who were identified as at risk for reading disabilities were provided with instruction in one of two reading programs for first and second grades. In addition to the finding that the code-based program was superior to the context-based program in improving achievement on a variety of reading and spelling measures, Felton (1993) reported several salient implications for instruction. Two of these, that "reading instruction must be intensive" (p.588) and that we must "teach for automaticity" (p.588), helped support the assertion that extensive practice is beneficial. She stated that instruction must include large amounts of practice in connected text and that the child must be exposed repeatedly to words until they become automatic.

Lyon (1998), in a presentation to the Committee on Labor and Human Resources, reported that the National Institute of Child Health and Human Development (NICHD) studies showed that children vary in the amount of practice that is needed for effective instruction. He stated that, while most children require between 4 and 14 repetitions to automatically recognize a new word, some may need 20 or more repetitions to reach automaticity. He concluded that extensive practice in reading at an independent level may help provide the multiple repetitions needed by some children.

A recent study by Mercer, Campbell, Miller, Mercer, and Lane (2000) supported Lyon's (1998) statement. A study involving 49 middle-school students provided repeated readings of phonemes, syllables, or nonsense sounds; sight phrases; and stories. The researchers concluded that the extensive practice afforded these students resulted in significant reading gains, with students who participated in the study for 19 to 25 months achieving reading growth of 3.14 grade levels, those participating for 10 to 18 months reporting gains of 3.08 grade levels, and those participating for 6 to 9 months reporting gains of 1.82 grade levels.

These studies lend support to LaBerge and Samuel's (1974) model which proposes that practice and overlearning lead to automaticity in word recognition. This automaticity is thought to free children from the struggle to recognize words and leave attention free for comprehension.

Treatment Resisters and Intensity

Effective programs contain elements of both phonological awareness and phonics. However, even in effective programs, there are "treatment resisters," or students who do not make adequate progress in reading.

Treatment Resisters

The study previously discussed, in which Lundberg et al. (1988) provided PA training to 235 preschool children, resulted in significant growth in phonological skills for most children. However, 6% of the experimental group showed no phonemic segmentation ability after training.

Schneider et al. (1999) reported similar results. In a longitudinal study designed to test the effectiveness of PA interventions on reading and spelling skills, Schneider et al. reported that the experimental group significantly outperformed the control group. Though they did not report the percentage of children who did not progress, the researchers did state that there were children in each treatment group who did not benefit from the training program.

Similarly, Vellutino et al. (1996) conducted a longitudinal study to determine how well "poor readers" responded to remediation, which included instruction in reading connected text and practice in PA, sight word recognition, and writing. The researchers found children who made little or no positive growth. In the study, 67% of children made substantial progress. However, 33% still scored below average range, and 15% still scored below the 15th percentile on individually administered tests of reading achievement.

Results from a study by Foorman, Francis, Fletcher, Schatschneider, and Mehta (1998) confirmed the previous results. Two hundred eighty-five first and second graders who were receiving Title I services were chosen for the study which compared Direct Code, Embedded Code, and Implicit Code instruction. The Direct Code instruction included explicit instruction in PA, phonics, and literature activities. The Embedded Code group also received PA instruction but focused on spelling patterns embedded in text. The Implicit Code group focused on the teacher as a facilitator and on the children's discovery of information. While the results indicated that the children in the Direct Code model showed stronger outcomes on measures of sight word reading, phonetic decoding, and passage comprehension, there were still children in this model who progressed very little. For example, 36% of the children in the direct code group scored below the 30th percentile in phonetic decoding, and 35% scored below the 30th percentile in word reading skills.

Recent researchers (Bowers & Wolf, 1993; Lovett et al. 2000; Wolf & Bowers, 1999; Wolf et al., 2000) have hypothesized that students who fail to respond to treatment may demonstrate a double-deficit: They may be deficient in both phonological awareness and rapid serial naming.

Double-Deficit Hypothesis

The double-deficit hypothesis assumes that rapid, automatized naming is a skill that is independent of phonological processing (Wolf & Bowers, 2000) and may represent a second core deficit, rather than a facet of phonological processing as has been previously assumed (Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997).

Denckla (1972) first observed that color-naming speed, rather than accuracy, distinguished dyslexic boys from average readers. This original study was followed by a series of studies (Denckla & Rudel, 1974, 1976) designed to investigate the relationship between rapid automatized naming (RAN) and reading disablility. Denckla and Rudel found that RAN of colors, objects, letters, and digits distinguished dyslexic children from other learning-disabled children as well as from average readers. Many researchers have assumed that this deficit is a part of a general phonological core deficit (Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997; Bowers & Wolf, 1993). However, recent researchers (Wolf, 1997) hypothesized that RAN represents a separate core deficit and that, when combined with a deficit in phonological processing, may lead to reading disabilities so profound they defy even our most current methods of remediation.

Researchers need to address this group of learners. Are the students who become treatment resisters comprised of this group of children who have double-deficits, and will greater intensity of instruction improve the performance of this resistant group, as well as the performance of more typical learners? Does greater intensity for this group of learners have to take the form of one-to-one tutoring, or might an increase in instructional time in a general classroom setting benefit these children with double-deficits?

Intensity of Instruction

Torgesen (2000) reported that approximately 2% to 6% of children may fail to make adequate progress in reading even if the most successful reading interventions are used. He reported that even though we know that explicit instruction in PA and decoding are the most effective approaches for children at risk for reading difficulties, we still do not know the amount of instruction, and the conditions under which it must be delivered, to reach these students. He suggested that research is needed to examine the intensity and duration of instruction needed to prevent reading difficulties in children with weaknesses in phonological processing skills.

O'Connor (2000) conducted a study which targeted levels of intensity. The first layer of intensity occurred in the kindergarten year and consisted of whole class activities which were designed to teach PA, letter sounds and names, and vocabulary. O'Connor's Level 1 followed Blachman's (1994) suggestion that children at risk for reading failure should receive structured PA instruction prior to identification for special services. Level 1 proved successful in reducing the number of children who were categorized at-risk from 59 of 189 children (31%) to 44 of 189 children (23%). The 44 children who still fell significantly behind other kindergarteners in blending and segmenting were targeted for Level 2 intervention to begin in January of the kindergarten year. However, only 25 of the 44 children had parent and teacher permission to participate. These children received one-to-one tutoring which incorporated the activities used for whole class instruction and focused on blending, segmenting, and matching sounds to words. Thirteen of the 25 children who participated showed enough progress to move out of the high-risk category, while 7 children failed to make gains in blending and segmenting (28%). In first grade, 30 children (21%) were identified as reading one or more standard deviations below the mean on the Woodcock Johnson letter-word and dictation subtests. Twenty of these children participated in a Level 3 intervention, which consisted of small group instruction which targeted letter sounds, decoding, and blending. Of this group, six of the children made only negligible gains (30%). These six children, plus four who continued to score low on an achievement test, and two who were identified as having disabilities, were selected for participation in a Level 4 intervention. This intervention focused on blending and spelling decodable words. Children worked one-to-one with tutors for 4 weeks. Six of these children achieved average reading scores, while six (3% of the original group) continued to respond poorly to treatment.

Blachman (1994) also conducted a study that was generally successful in teaching prereading skills but that also found some children resistant to treatment. In the study which targeted 84 treatment children and 75 control children for 11 weeks of training in phoneme segmentation and letter name and letter sound instruction, Blachman reported that the treatment group significantly outperformed the control group on phoneme awareness, letter-sounds and letter-names, and word and nonword recognition. Although Blachman stressed that, as the length and complexity of treatment increased, fewer children failed to make progress, she emphasized that there is a real need to discover more about the optimal "length, intensity, and timing of treatment, as well as the best combination of instructional components" (p. 290) to help reduce the number of resisters to intervention.

The Report of the National Reading Panel (NICHD, 2000) reiterated this view. The report pointed out that, while intensive, systematic instruction is often endorsed, the term "intensive" is not defined. There is no indication regarding the length of instruction required to achieve mastery for kindergarten, first-, or second-grade students. The report emphasized that further research is needed in this area.

Practical Classroom Application

Most studies focused on intensive interventions in one-to-one or small group settings outside of the regular classroom. However, this arrangement is often not practical in general classroom settings for financial or personnel reasons.

Blachman (1991) addressed this concern in a study of 84 kindergarten children in a treatment group and 75 children in a control group. The children in the treatment group received instruction in PA and sound-symbol relationships in small groups in their regular kindergarten classrooms. The students in the control group received no special instruction. After intervention, the students in the treatment group outperformed the students in the control group on phoneme segmentation, letter-sound knowledge, invented spelling, and the reading of words and nonwords. A drawback of the generalizability of this study to regular kindergarten classrooms was the fact that the each teacher had a teaching assistant who worked with her/him and allowed the teacher to work with small groups of students. Again, this arrangement is not always feasible in a kindergarten classroom. Therefore, attention should be given to increasing the intensity of instruction in a whole-class format.

Implications for Research

The review of the literature in this chapter provided a conceptual and theoretical basis for this research study. Researchers demonstrated that a deficit in PA constitutes a core deficit for most students with reading difficulties. In addition, it was shown that instruction in PA results in improved performance in reading. It further was demonstrated that such instruction should be combined with explicit, systematic instruction in phonics if reading achievement is to be optimized. However, even with instruction in both PA and phonics, there are students who fail to learn to read at an average level of achievement. It was hypothesized that the students in this group of treatment resisters might be comprised largely of children who have a double-deficit in PA and in rapid naming. It was further speculated that the number of students in this group might be decreased with greater intensity of instruction. Such intensity has typically been achieved through one-to-one or small group instruction that is often not feasible in kindergarten classrooms. It was not determined whether an increase in intensity in whole class instruction would reduce the number of treatment resisters and increase the reading achievement of students as a whole. Therefore, this study compared the achievement of students who were instructed in a whole-class Direct Instruction program that emphasizes PA and phonics, students who were instructed in the same Direct Instruction program with a whole-class supplemental program in PA, and students who received only typical kindergarten classroom instruction which was supplemented by computer-assisted PA instruction.

CHAPTER 3
METHODS AND PROCEDURES

Introduction

The purpose of this study was to determine the effects of intensity of instruction in phonological awareness (PA) on the acquisition of literacy skills. The study compared three groups. Children in Group A received training in a Direct Instruction program in reading that included an emphasis on PA. Children in Group B received training in the same Direct Instruction program and received additional training in PA each week. Children in Group C received only PA training, delivered through computer-assisted instruction. For the study, the average number of minutes of instruction in PA was calculated for each group for the kindergarten year. The effect of the intensity of instruction in PA during the kindergarten year on PA, phonological memory, rapid naming, and reading skills was examined at the end of kindergarten. The lasting effects of such instruction were examined by measuring reading skills at the end of first grade. The number of children who scored below the 30th percentile on each measure at the end of kindergarten was determined for each group. This group was examined to determine whether the children in the group fit the profile of students with double-deficits, or students with deficits in both PA and rapid naming.

The first section of Chapter 3 gives the hypotheses which were addressed. The second section includes a description of the research settings, sampling procedures, and subjects. The third section provides a description of research instrumentation, while the final sections describe the experimental design, the instructional procedures, and the analysis of the data.

Hypotheses

A study of the effect of the intensity of instruction in PA was conducted. Eleven hypotheses regarding the acquisition of phonological awareness, phonological memory, rapid naming, and reading skills were formulated. The following general research question was asked: Does the level of intensity of instruction in phonological awareness affect the acquisition of phonological processing or reading skills? To address this question, the following hypotheses were tested at the .05 level of confidence.

H_1: There will be no statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on standardized measures of phonological awareness, including elision, blending, and sound matching.

H_2: There will be no statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of phonological memory.

H_3: There will be no statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of rapid naming.

H_4: There will be no statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of nonword reading.

H_5: There will be no statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of word reading.

H_6: There will be no statistically significant difference, at the end of kindergarten, in the frequency of children who test below the 30th percentile on any of the standardized measures used, between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness.

H_7: Of the percentage of children who test below the 30th percentile on measures of word or nonword reading at the end of kindergarten, there will be no statistically significant difference in the frequency of students who evidenced a double-deficit in PA and rapid naming, either at the beginning or middle of kindergarten, and students who did not evidence a double-deficit in PA and rapid naming.

H_8: There will be no long-term statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of nonword reading, administered a year after the end of treatment.

H_9: There will be no long-term statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of word reading, administered a year after the end of treatment.

H_{10}: There will be no long-term statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct

Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a measure of oral reading fluency, administered a year after the end of treatment.

H_{11}: There will be no long-term statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a measure of reading comprehension, administered a year after the end of treatment.

Methods

This section includes a description of the research settings, sampling techniques, and subjects. Demographic information is provided for each research setting. The instruments used to provide pretest and posttest information are described. Instructional procedures for each group are detailed, and methods of data analysis are provided.

Settings and Subjects

The purpose of this section is to describe the research settings and the method of selection of students. Statistics regarding the socioeconomic status of the schools are presented.

Instructional Settings

Two public elementary schools in north central Florida were selected for this study. Since socioeconomic status is considered to be a factor associated with reading achievement (Adams, 1990; Snow et al., 1998), the socioeconomic status of the participating schools was considered. Each school had greater than the state average of 56% of the students participating in the free or reduced lunch program. Elementary School A had a free/reduced lunch rate of 59.6%, while Elementary School B had a free/reduced lunch rate of 70.1%. This was considered appropriate as it was hypothesized that such populations would provide greater numbers of students with weak phonological awareness skills. The first school served a predominately rural area, while the second school served a primarily suburban population.

Subject Selection

All students included in the study were kindergarten students. Students from all eight kindergarten classrooms in Elementary School A and both kindergarten classrooms in Elementary School B participated in the study. All students spoke English as their primary language. All students were randomly assigned to kindergarten classrooms at the beginning of the school year.

Kindergarten students were listed in alphabetical order by class. An interval sampling technique was used to select students for the study.

Kindergarten teachers participated in this project on a voluntary basis. Each teacher was an experienced kindergarten teacher, and all were certified in early childhood education.

Four of the kindergarten classrooms from School A were assigned to provide Direct Instruction in a reading program which emphasized phonological awareness to their students. Four classrooms from School A were assigned to provide the same Direct Instruction reading program and to supplement the program with additional instruction in phonological awareness. The two classrooms from School B provided a computer-assisted program in phonological awareness. The average number of minutes that students in each group received instruction in phonological awareness was determined. In this way, the effect of intensity of instruction in phonological awareness was examined.

Frequencies were determined for the following variables: gender, ethnicity, and socioeconomic status. The frequencies for the aforementioned demographics for all study participants are presented in Table 1, while the

Table 1

Demographic Data for All Study Participants

	Frequency	Percent
Gender		
Female	47	44.8
Male	58	55.2
Total	105	100.0
Ethnicity		
Black	39	37.1
White	62	59.0
Hispanic	2	1.9
Mixed	2	1.9
Total	105	100.0
SES		
Free Lunch	58	55.2
Reduced Lunch	10	9.5
Full Pay Lunch	37	35.2
Total	105	100.0

demographics for participants by group are presented in Table 2.

Permission to conduct the study was granted by the University of Florida Institutional Review Board.

Table 2

Demographic Data for Participants by Group

	DI Plus PA Group		DI Group		Computer-Assisted PA Group	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Gender						
Female	15	14.3	17	16.2	15	14.3
Male	18	17.1	19	18.1	21	20.0
Ethnicity						
Black	7	6.7	13	12.4	19	18.1
White	25	23.8	22	21.0	15	14.3
Hispanic	1	1.0	0		1	1.0
Mixed	0		1	1.0	1	1.0
SES						
Free	10	9.5	20	19.0	28	26.7
Reduced	3	2.9	4	3.8	3	2.9
Full Pay	20	19.0	12	11.4	5	4.8
Total	33	31.4	36	34.3	36	34.3

Research Instrumentation

The research instruments selected for use in this study are described in this section. Pretests included measures of phonological awareness, phonological memory, and rapid naming, which make up the composite score for phonological processing. Also included were measures of word and nonword reading efficiency. A longitudinal follow-up included measures of word and nonword reading efficiency in the fall and spring of the first-grade year and measures of oral reading fluency and reading comprehension in the spring of the first grade-year.

Measures of Phonological Processing

The Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999) was administered to all participants in the fall, winter, and spring of the kindergarten year. The test consists of three composite tests: phonological awareness, which is represented by subtests in elision, blending, and sound matching; phonological memory, which is represented by tests in memory for digits and nonword repetition; and rapid naming, which is comprised of tests in the rapid naming of colors and objects.

Phonological awareness. The first composite score, Phonological Awareness, is composed of the standard scores of three subtests: Elision, Blending Words, and Sound Matching (see Appendix A). The score represents a child's awareness of the sound structure of language.

For the Elision subtest, the student was asked to leave out part of a word. This subtest began with the deletion of one syllable of a compound word (e.g., "Say *toothbrush*. Now say *toothbrush* without saying *tooth*."). It progressed to a more difficult skill, that of deleting one phoneme of a word (e.g., "Say *cup*. Now say *cup* without saying /k/."). The most difficult skill represented was that of deleting a phoneme in the middle of a word (e.g., "Say *tiger*. Now say *tiger* without saying /g/."). The test was discontinued when the student missed three items in a row.

For the Blending Words subtest, the student was asked to listen to an audiocassette pronunciation of word parts or individual sounds and then blend the parts to make a word. The subtest began with the easier skill of blending word parts (e.g., "What word do these sounds make? can-dy.") to the more difficult sound of blending phonemes (e.g., "What word do these sounds make? m-a-d."). The most difficult response involved the blending of multiple phonemes (e.g., "What word do these sounds make? m-a-th-e-m-a-t-i-k-s."). When the student missed three consecutive items, the test was discontinued.

For the Sound Matching subtest, the student matched words by beginning sounds (e.g., "Which word starts with the same sound as *pan*? *pig, hat*, or *cone*?"). If the student missed fewer than four of seven items, he or she was asked to match words by ending sounds (e.g., "Which word ends with the same sound as *hill*? *doll, hat*, or *whip*?"). If he missed four of seven items, the test was discontinued.

Phonological memory. Phonological memory refers to the coding of information for storage in short-term or working memory. The Phonological Memory composite score is composed of standard scores from the subtests, Memory for Digits and Nonword Repetition (see Appendix B). A weakness in phonological memory skills has been shown to impair a student's decoding of new words (Wagner et al., 1999).

The Memory for Digits subtest required that the student repeat a string of digits presented through an audiorecording. Each number string was played only once. The child was initially required to repeat two digits. At the most difficult level, the child was asked to repeat eight digits, although the test was discontinued when the student missed three items in a row. The rate of digit presentation was rather rapid to discourage verbal rehearsal strategies. Only forward recall of digits was required.

The Nonword Repetition subtest required that the student repeat words heard on an audiocassette recorder.

Each nonword was played only once. The first items were nonwords with only one syllable (e.g., "*ral*"), while the most difficult responses were multisyllabic (e.g., "*sha-bur-i-hu-voi-mush*"). The subtest was discontinued when a student missed three consecutive items.

Rapid naming. The Rapid Naming Composite Score is composed of standard scores on subtests of Rapid Color Naming and Rapid Object Naming (see Appendix C). Rapid naming measures an individual's ability to retrieve information from long-term memory and the efficiency with which an individual executes a series of tasks. Those who have difficulty with these tasks have been shown to frequently have difficulty with reading fluency (Wagner et al., 1999).

The student's score on Rapid Color Naming is the number of seconds required to name the colors of 72 colored blocks printed on two pages. Each page contains four rows and nine columns of colored blocks that have been randomly arranged. If the student missed the names of four colors on the first page, the test was discontinued.

The Rapid Object Naming subtest measures the speed with which the child names a series of objects on two pages. Each page contains four rows and nine columns of randomly arranged drawings of common objects (i.e., pencil, star, fish, chair, boat, key). The score is the number of seconds required to name objects on both pages. The test was discontinued if the child made more than four errors on the first page.

Reliability of CTOPP. The test manual examines three types of reliability: content sampling, time sampling, and interscorer differences (Wagner et al., 1999). The reliability reported is consistently high across all three types of reliability, which indicates that the CTOPP contains little test error.

Coefficient alphas are reported for the CTOPP in the CTOPP manual. Cronbach's alpha was used to determine the internal consistency of all subtests except for those of rapid naming. Because they are timed tests, the more appropriate alternate-form reliability procedure was used for these tests. For five- and six-year-olds, these coefficient alphas range from .74 to .93 for the CTOPP subtests, indicating strong homogeneity among items within each subtest, thus supporting the reliability of the CTOPP.

Validity of CTOPP. The CTOPP manual reports evidence of three types of validity: content description, criterion prediction, and construct identification. Both quantitative and qualitative evidence is provided for content validity. The logistic regression procedure was used to study bias in the CTOPP items. Items that appeared to be biased against any particular groups, when male/female or various ethnic groups were compared, were eliminated from the test. A Delta Scores approach was also employed to examine bias between the aforementioned groups. The coefficients obtained indicated little or no bias between groups. Based on the information provided in the manual, the CTOPP can be used with confidence to measure phonological processing, especially with groups in which bias is frequently a problem.

In examining the criterion-prediction validity of the CTOPP, scores were correlated with those from the Woodcock Reading Mastery Tests-Revised (WRMT-R; Woodcock, 1987). Strong correlations were found for Phonological Awareness and Rapid Naming, while modest correlations were found for for Phonological Memory. In addition, the CTOPP was correlated with The Test of Word Reading Efficiency (TOWRE; Torgesen et al., 1999). The particularly strong correlations found between the Phonological Awareness composite score and the TOWRE for kindergarten and first-graders support the relationship between phonological awareness and reading fluency.

Confirmatory factor analysis was used to support the construct-identification validity of the CTOPP. The

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analysis supported the model upon which the CTOPP is based. The model supposes that phonological processing is based on three separate, but related, phonological processing abilities: phonological awareness, phonological memory, and rapid naming.

Measures of Word and Nonword Reading Efficiency

The TOWRE was used to measure each child's ability to read printed words accurately and fluently. The test is composed of two subtests: Sight Word Efficiency and Phonemic Decoding Efficiency (see Appendices D and E). These tests are considered to be accurate indicators of a young child's reading ability. Torgesen et al. (1999) reported that children who become poor readers have difficulty on two types of reading tasks: accurately and fluently decoding unknown words and accurately and fluently identifying sight words. The TOWRE tests these two types of tasks. The Sight Word Efficiency subtest requires that the student read as many sight words as possible in 45 seconds, while the Phonemic Decoding Efficiency subtest requires that the student read as many nonwords as possible in the same amount of time.

Reliability of TOWRE. The test-retest reliability for the TOWRE equals or exceeds .90 for each form of each subtest. In addition, the average correlation coefficients demonstrating the relationship between forms A and B of the TOWRE exceed .90.

Validity of the TOWRE. Concurrent validity for the TOWRE was established by comparing end of year scores of the Phonemic Decoding Efficiency subtest and the Word Attack subtest of the Woodcock Reading Mastery Tests-Revised (WRMT-R; Woodcock, 1987). The correlation between the end of year scores on the two subtests was determined to be .85. The correlation between the Sight Word Efficiency subtest of the TOWRE and the Word Identification subtest of the WRMT-R was found to be .89.

Measures of Oral Reading Fluency and Reading Comprehension

The Qualitative Reading Inventory-II (QRI-II; Leslie & Caldwell, 1995) was administered to all participants in the spring of the first-grade year, a year after the study had ended, to determine longitudinal effects of the interventions (see Appendix F). Measures of fluency and comprehension were determined.

Oral reading fluency. For this assessment, the student was asked to read a first-grade passage. The reading was timed to determine oral reading fluency and recorded as the number of correct words read in 1 minute.

Reading comprehension. The reading comprehension score was determined using the passage read for fluency. After reading the passage, the student was asked to recount the story, including as many details as possible. The number of correct details included in the retelling constituted the reading comprehension score.

Reliability of the QRI-II. The QRI-II reports reliability measures for interscorer reliability, internal consistency, and alternate-form reliability. The manual states the interrater reliability to be .98 for measures of both correct words read and correct details recounted, which indicates a high degree of consistency between scorers. The internal consistency measure gives an indication of how reliably the score estimates the true score. The standard error of measurement (SEM) was determined to be an appropriate indicator for the QRI-II, because it is a critierion-referenced test and because the reduced variability, which results from administering only grade-level tests to the subjects, would make a correlational estimate inappropriate. The SEM for the first-grade passage used was reported to be .18. The manual reports the alternate-form reliability for the first-grade passages to be .86, which indicates that 86% of the time the same level would be determined from two first-grade passages.

Validity of the QRI-II. The manual reports data for criterion-related validity of the QRI-II. Concurrent validity of the test was examined by comparing the levels obtained from the QRI-II to those obtained from the California Achievement Test or the Iowa Test of Basic Skills. For grade 1, a correlation of .86 was reported, which indicates that the tests compared are measuring common factors which are reported as instructional levels.

Experimental Design

A pretest-posttest design was used for the study. The three groups compared were (a) the treatment group, or the group receiving Direct Instruction in reading plus phonological awareness instruction; (b) comparison group A, or the group receiving only Direct Instruction in reading; and (c) comparison group B, the group receiving only computer-assisted instruction in phonological awareness. The mean number of minutes each group received instruction in PA was determined to examine the effect of intensity of instruction in PA on the acquisition of literacy skills. The experimental design, demonstrated in Table 3, allowed for the assessment of the change in the dependent variables over time.

Table 3

Experimental Design

Group	Design			
Treatment Group	O_1	X_2	O_3	O_4
Comparison Group A	O_1	X_2	O_3	O_4
Comparison Group B	O_1	X_2	O_3	O_4

Instructional Procedures

This section describes instructional procedures. A description of the training of teachers who instructed students in the Direct Instruction reading program is provided. In addition, the training provided for those who taught the phonological awareness intervention component is included. Finally, a description of instruction provided in each group is supplied.

Teacher Training

Each of the teachers providing instruction in the Direct Instruction reading program participated the preceding year in 2 days of training for the program. The training was sponsored by Science Research Associates and was presented by a consultant who was an experienced trainer for the program. The training included both a research rationale for the program and practice in delivering the lessons appropriately.

The teachers delivering the supplemental phonological awareness training were initially trained by the researcher in a 2-hour session. In addition, each teacher participated in a 2-hour training offered by the school district in the program. Each received a copy of the book, Phonemic Awareness for Young Children: A Classroom Curriculum (Adams, Foorman, Lundberg, & Beeler, 1998), and a set of picture cards to use in delivering the activities.

The teachers who had the computer-assisted program available for their students to use participated in two 3-hour training sessions delivered by a consultant from Electronic Education. The training focused on the management of the Waterford Computer System (Waterford Institute, 1993), with about an hour of the training devoted to practice in the computer activities. About a half-hour was spent discussing the importance of proficiency in letter recognition and letter-sound recognition and the importance of phonological awareness to the reading process.

The Direct Instruction Reading Intervention

Students in both the Treatment Group and in Comparison Group A received Direct Instruction in reading. For both groups, instruction occurred approximately 4 days a week, for about 20 minutes. Because teachers occasionally replaced their instruction with special activities, such as holiday celebrations, teachers were asked to supply the number of minutes spent weekly in reading instruction, and the minutes were totaled for the year. Means were determined for each group. Because the intensity of instruction in phonological awareness is the variable being examined, and because an average of one-third of each Direct Instruction lesson was devoted to phonological awareness, one-third of the average minutes each group spent in the DI program was used in the final calculations. Children in the treatment group were determined to have spent an average of 994.95 minutes in PA instruction through the DI program, while those in Comparison Group A were found to have spent an average of 1009.8 minutes in PA instruction through the DI program. This method of comparison effectively addresses the effect of the intensity of instruction in phonological awareness provided for students in each group.

The Direct Instruction program used was Reading Mastery I (Engelmann & Bruner, 1995). The program teaches basic decoding and comprehension skills through 160 lessons. The first 27 lessons focus on sound pronunciation, sequencing, oral blending, and rhyming. Lessons 27-74 focus on saying words quickly and slowly, symbol identification, word recognition, and story reading. Lessons 75-160 focus on symbol identification, word recognition, and story reading. None of the classes used the Take-Home Books, which are intended to provide extra practice in, and application of, newly acquired skills. A sample of a typical lesson in Reading Mastery I is provided in Appendix G.

The lessons in Reading Mastery are scripted. This helped to ensure consistency across instructional groups. The scripts also include specific correction procedures, which follow the model-lead-test-retest procedure. Lessons provide a high rate of repetition of newly introduced skills and regularly scheduled repeated practice on previously introduced skills.

The Phonological Awareness Intervention

Students in the Treatment Group received instruction in a supplemental program in phonological awareness, in addition to the instruction they received in the Direct Instruction reading program. Phonemic Awareness for Young Children: A Classroom Curriculum (Adams et al., 1998) was used as a lesson source for instruction. Teachers in the treatment group agreed to deliver the instruction 4 days per week. However, once again special activities occasionally interrupted the day. Therefore, teachers were asked to record the number of 15-minute lessons accomplished each week, and an average was obtained for the treatment group. Children in the treatment group were found to have spent an average of 1,620 minutes in supplemental PA instruction, which, when added to the PA instruction they received through the DI program, totals 2614.95 minutes.

Phonemic Awareness for Young Children contains a suggested sequence of lessons, which the teachers were asked to follow. Activities in the following areas are presented in the instructional manual: Listening Games, Rhyming, Words and Sentences, Awareness of Syllables, Initial and Final Sounds, Phonemes, and Introducing Letters and Spellings. A sample lesson is presented in Appendix H.

The Computer-Assisted Instruction Intervention

Students in Comparison Group B received computer-assisted instruction in phonological awareness and other prereading skills from January through May. Instruction occurred daily for about 15 minutes. Electronic Education's Waterford Early Reading Program was used for each student. The computer recorded the total number of minutes each student spent on computerized instruction. The mean number of minutes spent by students in Comparison Group B was determined. Since the Waterford program devotes approximately one-fourth of the instructional time to phonological awareness activities, one-fourth of the mean number of minutes spent by students in the group on computer-assisted instruction was used in the analysis of data. The mean number of minutes per child spent on the Waterford program was 1046.2 minutes (Waterford Institute, 1993). Therefore, 261.55 minutes per child were calculated as the time spent engaged in PA activities.

The Waterford Early Reading Program is highly interactive. For instance, when learning to recognize a letter, a student is asked to touch a ball on the screen and follow the ball to trace a letter shape. Then the student is asked to write the same letter on a piece of paper while the computer waits a prescribed amount of time.

Frequently, the student is asked to sing along with the computer to a variety of alphabet songs. The same songs are recorded on four videocassettes, which each student is given to use at home. Students "read" words along with a bouncing ball on screen and then can print the stories read to take home. In addition, each student is given 52 small books to take home for reading practice. Each book is a copy of one the student has previously "read" on the computer. After each student response, the computer praises the student for correct responses or rehearses correct responses with the student for incorrect responses. If the student receives a score of less than 75%, the computer has the student repeat the activity in the following sessions until mastery is reached.

Treatment of the Data

The purpose of this study was to examine the effects of intensity of instruction in phonological awareness on the acquisition of reading skills in young children. In order to evaluate the effects of a Direct Instruction reading program, a Direct Instruction reading program with a supplemental treatment in phonological awareness, and a computer-assisted program in phonological awareness, 11 hypotheses were tested.

Pretest data were collected on all subjects using the CTOPP and the TOWRE. The mean scores of each group on the pretests were compared, using an ANOVA, to determine whether significant differences existed between the groups at the onset of the study.

To test Hypotheses 1 through 5, the pretest measures were used as covariates, and a series of analyses of covariance (ANCOVAs) were performed on data from the end of the kindergarten year on each of the following dependent variables: (a) phonological awareness, (b) phonological memory, (c) rapid naming, (d) sight word reading efficiency, and (d) nonword reading efficiency. Group (treatment, comparison A, and comparison B) served as the independent variable. To test for Hypotheses 8 through 11, which addressed the long-term effects of treatment, ANCOVAs or ANOVAs were run for sight word reading efficiency, nonword reading efficiency, oral reading fluency, and reading comprehension in the spring of the first-grade year. Finally, to test for Hypothesis 6, chi-square measures were used in both the spring of kindergarten and the fall of the first-grade year to compare the percentage of each group falling below the 30th percentile on each of the literacy skills measured. Ch-square measures were also used for Hypothesis 7 to further examine the group of children who scored below the 30th percentile to determine whether a significant percentage of this group evidenced a double-deficit in rapid naming and PA, either at the beginning or middle of kindergarten.

CHAPTER 4
RESULTS

Introduction

This study examined the effectiveness of increasing the intensity of class-wide instruction in phonological awareness on the acquisition of prereading and reading skills of young children. The following general research questions were addressed:

1. Does an increase in the intensity of instruction in PA, in a regular classroom setting, affect the development of literacy skills?

2. Does greater intensity of instruction in PA, in a regular classroom setting, reduce the number of students who score below the 30th percentile on tests of literacy skills?

3. Does the group of students who score below the 30th percentile on tests of literacy skills contain a significant number of students with a double-deficit in PA and rapid naming?

4. Does greater intensity of instruction in PA, in a regular classroom setting, result in a long-term difference in literacy skills?

To answer these questions, the preliteracy and literacy skills of three groups were tested in the fall of kindergarten, the spring of kindergarten, and the spring of first grade. The treatment group was instructed in a Direct Instruction reading program and a PA activity program, Comparison Group A in the Direct Instruction reading program only, and Comparison Group B in computer-assisted instruction in PA. The mean number of minutes of PA instruction for each group was determined in order to compare the effects of intensity of instruction in PA.

Eleven hypotheses were tested to address the general research questions. Chapter 4 provides the statistical analysis of the resulting data.

The first five hypotheses, illustrated in Table 4, involved testing the students in the fall and spring of kindergarten. Pretest scores were used as covariates for nine dependent measures.

A series of chi-square tests were used to test Hypothesis 6, which compared the number of students in each group scoring below the 30th percentile on the measures

Table 4

Null Hypotheses Tested Using A Series of Analyses of Covariance or Interaction Models

Dependent Measures	Pretests and Postests for All Groups (Fall and Spring of K)
1. Sound Matching 2. Elision 3. Blending Words	H_1: There will be no statistically significant difference between the groups on measures of phonological awareness.
4. Memory for Digits 5. Nonword Repetition	H_2: There will be no statistically significant difference between the groups on measures of phonological memory.
6. Rapid Colors 7. Rapid Objects	H_3: There will be no statistically significant difference between the groups on measures of rapid naming.
8. Nonword Reading	H_4: There will be no statistically significant difference between the groups on a measure of nonword reading.
9. Word Reading	H_5: There will be no statistically significant difference between the groups on a measure of word reading.

collected at the end of kindergarten. The model for this comparison is illustrated in Table 5.

Additional chi-square tests were used to test Hypothesis 7, which examined the relationship between the number of students scoring below the 30th percentile in word and nonword reading, and the presence or absence of a double-deficit in phonological awareness and rapid naming, either at the beginning or middle of kindergarten. This analysis is illustrated in Table 6.

Table 5

The Chi-Square Design for Comparing Frequency Counts of Students Scoring Below the 30th Percentile

Chi-Square Test:

	Treatment Group	Comparison Group A	Comparison Group B
>30th percentile	Frequency Count	Frequency Count	Frequency Count
<30th percentile	Frequency Count	Frequency Count	Frequency Count

Table 6

The Chi-Square Design for Comparing the Number of Students Scoring Below the 30th Percentile To Number of Students Evidencing Double-Deficits

Chi-Square Test:

	Double-Deficit at the Beginning of K	
	Yes	No
>30th percentile	Frequency Count	Frequency Count
<30th percentile	Frequency Count	Frequency Count

Chi-Square Test:

	Double-Deficit at the Middle of K	
	Yes	No
>30th percentile	Frequency Count	Frequency Count
<30th percentile	Frequency Count	Frequency Count

The last four hypotheses, illustrated in Table 7, involved testing the students at the beginning of kindergarten and at the end of first grade. These hypotheses addressed the differences in the groups on nonword and word reading, on oral reading fluency, and on comprehension.

Table 7

Null Hypotheses Tested Using ANOVAs, ANCOVAs, or Interaction Models

Dependent Measures	Pretests and Posttests for All Groups in Fall of Kindergarten and Spring of First for Nonword and Word Reading. Spring of First Only for Fluency and Comprehension.
10. Nonword Reading	H_8: There will be no statistically significant difference between the groups on a measure of nonword reading.
11. Word Reading	H_9: There will be no statistically significant difference between the groups on a measure of word reading.
12. Reading Fluency	H_{10}: There will be no long-term statistically significant difference between the groups on a measure of oral reading fluency.
13. Comprehension	H_{11}: There will be no long-term statistically significant difference between the groups on a measure of reading comprehension.

Statistical Analysis of the Data

This section presents an analysis of the data. The initial analysis, conducted to determine preexisting differences in the groups, is discussed. The analyses conducted to address the various hypotheses are also addressed.

Equivalency of Intervention Groups

The data for the study were collected in two elementary schools. Of the original 128 children tested, 23 were removed from data analysis due to student mobility. The group means of the pretests of the remaining 105 students, who were divided into a treatment group and two comparison groups, were compared using a one-way analysis of variance (ANOVA) to determine comparability of groups. The results of the ANOVA are reported in Table 8. No significant differences existed between the groups on the pretest, except in the area of phonological awareness. The low pretest score of Comparison Group B (computer-assisted instruction in PA) most likely contributed to the initial difference. No ANOVA comparison could be made for the test of nonword reading efficiency, as all students scored 0 on this pretest. The pretest means are presented in Table 9.

Table 8

Summary of Analysis of Variance for Dependent Measures Pretest

Dependent Measure	Sum of Squares	df	Mean Squares	F	Sig.
Phonological Awareness					
Between Groups	820.639	2	410.319	3.638	.030*
Within Groups	11503.323	102	112.778		
Total	12323.962	104			
Phonological Memory					
Between Groups	534.398	2	267.199	1.565	.214
Within Groups	17413.659	102	170.722		
Total	17948.057	104			
Rapid Naming					
Between Groups	248.108	2	124.054	.432	.650
Within Groups	28689.329	100	286.893		
Total	28937.437	102			
Sight Words					
Between Groups	15.665	2	7.833	1.985	.143
Within Groups	402.525	102	3.946		
Total	418.190	104			
Non-words					
Between Groups	.000	2	.000		
Within Groups	.000	102	.000		
Total	.000	104	.000		

*Significant at the .05 level.

Table 9

Dependent Measures Pretest Means By Group

Dependent Measure	Treatment Group DI and PA (n = 33)	Comparison Group A DI (n = 36)	Comparison Group B CAI in PA (n = 36)
	Mean (SD)	Mean (SD)	Mean (SD)
PA SS	92.94 (10.83)	93.06 (9.62)	87.11 (11.35)
PM SS	92.18 (14.29)	95.42 (11.99)	90.00 (12.93)
RAN SS	94.30 (19.31)	92.06 (16.60)	90.47 (14.69)
SW Raw	.30 (.81)	1.00 (3.26)	.11 (.52)
NW Raw	.00	.00	.00

Analysis of Data for the Testing of Hypotheses 1 Through 5

For Hypotheses 1 through 5, ANCOVAs were to be used to test for significance. Before the ANCOVAs were conducted, the assumption of homogeneity of slope was tested for each analysis. The data collected met the assumption of homogeneity of regression slopes for measures of phonological memory, rapid naming, nonword reading fluency, and word reading fluency. The assumption was not met for phonological awareness, as the Interaction Model used to analyze the PA data resulted in a significant interaction.

Phonological awareness. Because the treatment group and the two comparison groups were significantly different on the pretest measures, and because there was a significant interaction detected in the data collected in Fall 1999 and Spring 2000 (F (2,99) = 6.236, p = .003], these data must be interpreted with caution. The summary of the interaction model is depicted in Table 10, and the graph of the interaction in Figure 4.

Table 10

Summary of the Interaction Model for Phonological Awareness

Source	Type III Sums of Squares	df	Mean Squares	F	P
Corrected Model	7501.080	5	1500.216	9.698	.000
Intercept	1637.101	1	1637.101	10.583	.002
Group	1945.279	2	972.639	6.287	.003
PA	6082.075	1	6082.075	39.316	.000
Group* PA	1929.329	2	964.665	6.236	.003*
Error	15315.167	99	154.699		
Total	1133262.000	105			
Corrected Total	22816.248	104			

*Significant at the p < .05 level.

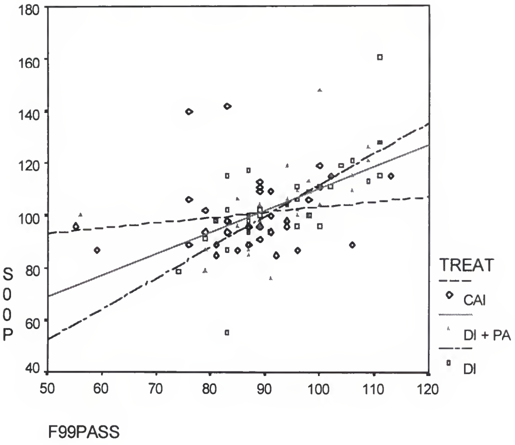

Figure 4. Graph of Interaction Model for Phonological Awareness Depicting Fall 1999 and Spring 2000 PA Scores.

Phonological memory. No preexisting significant difference was noted in the groups on phonological memory. The test of homogeneity of the regression slopes revealed no treatment by covariate interaction [F (2,99) = 2.178, p = .119] . Therefore, the ANCOVA was run without the interaction term. However, no significant differences in the groups were detected. The results of the ANCOVA for the dependent variable, phonological memory, is provided in Table 11.

Table 11

Summary for the Analysis of Covariance for the Phonological Memory Composite Scores

Source	Type III Sums of Squares	df	Mean Squares	F	P
Corrected Model	10927.901	3	3642.634	32.239	.000
Intercept	1632.022	1	1632.022	14.444	.000
Group	97.085	2	48.542	.430	.652
PM	10476.426	1	10476.426	92.722	.000
Error	11411.756	101	112.988		
Total	1079552.000	105			
Corrected Total	22339.657	104			

Rapid naming. No significant treatment by covariate interaction was determined for the data collected in Fall 1999 and Fall 2000 [F (2,97) = 1.651, p = .197]. When the ANCOVA was conducted without the interaction term, significant differences were detected. Therefore, pairwise comparisons were analyzed. A significant difference was detected between the Treatment Group and the CAI group, but not between the Treatment Group and the DI group or between the DI Group and the CAI group. The pairwise comparisons are reported in Table 13.

Table 12

Summary of the Analysis of Covariance for the Rapid Naming Composite Scores

Source	Type III Sums of Squares	df	Mean Squares	F	P
Corrected Model	102115.435	3	3405.145	20.479	.000
Intercept	6752.268	1	6752.268	40.609	.000
Group	1270.330	2	635.165	3.820	.025*
RAN	8261.697	1	8261.697	49.687	.000
Error	16461.089	99	166.274		
Total	954922.000	103			
Corrected Total	26676.524	102			

*Significant at the $p < .05$ level.

Table 13

Pairwise Comparisons for Rapid Naming

Group I	Group J	Mean Difference (I-J)	Standard Error	Significance
DI + PA	DI + PA			
	DI	5.870	3.112	.187
	CAI	8.558*	3.165	.024
DI	DI + PA	-5.870	3.112	
	DI			
	CAI	2.689	3.086	1.000
CAI	DI + PA	-8.558*	3.165	.024
	DI	-2.689	3.086	1.000
	CAI			

*Significant at the $p < .05$ level.

Adjusted group means, reported in Table 14, reveal the adjusted mean for the treatment group to be higher than that for the comparison groups, and the adjusted mean for the DI group to be higher than that of the CAI group.

Table 14

Adjusted Group Means for Rapid Naming

Group	Mean	Standard Deviation	N
DI + PA	99.809	2.250	33
DI	93.939	2.149	36
CAI	91.250	2.216	34

Nonword recognition fluency. Because all students scored 0 on the nonword recognition fluency pretest, the interaction between the treatment and covariate could not be determined. Therefore, the data were analyzed using an ANOVA, which revealed a significant treatment effect for this measure [F (2,101) = 3.481, p .035] . The results for comparison of the data collected in Fall 1999 and Spring 2000 are illustrated in Table 15. Pairwise comparisons indicated that the treatment group mean difference was significantly higher than that of the CAI group but not that of the DI group. There was no significant difference in the scores of the DI and CAI comparison groups. The

Table 15

Summary for the Analysis of Variance for Nonword Recognition Fluency

Source	Type III Sum of Squares	Df	Mean Square	F	Significance
Corrected Model	129.880	2	64.940	3.481	.035
Intercept	984.623	1	984.623	52.786	.000
Group	129.880	2	64.940	3.481	.035*
Error	1883.966	101	18.653		
Total	2974.000	104			
Corrected Total	2013.846	103			

*Significant at the $p < .05$ level.

pairwise comparisons and group means are presented in Tables 16 and 17.

Word recognition fluency. The assumption of homogeneity of slope was met for this comparison as no significant interaction was found [F (2,99) = 1.829, p = .166] . When the ANCOVA was run with the interaction term removed, a significant treatment effect was found [F (2,101) = 4.205, p = .018] , which is illustrated in Table 18. Therefore, pairwise comparisons were conducted, which revealed that the treatment group scored significantly higher than the CAI group but not the DI Group. No other

Table 16

Pairwise Comparisons for Nonword Recognition Fluency

Group I	Group J	Mean Difference (I-J)	Standard Error	Significance
DI + PA	DI + PA			
	DI	1.776	1.048	.280
	CAI	2.715*	1.041	.031
DI	DI + PA	-1.776	1.048	.280
	DI			
	CAI	2.689	1.025	1.000
CAI	DI + PA	-2.715*	1.041	.031
	DI	-.939	1.025	1.000
	CAI			

*Significant at the *p* < .05 level.

Table 17

Group Means for the Nonword Recognition Fluency Posttest

Group	Mean	Standard Error	N
DI + PA	4.576	.752	33
DI	2.800	.730	36
CAI	1.861	.720	36

Table 18

Summary of the Analysis of Covariance for Word Recognition Fluency

Source	Type III Sums of Squares	df	Mean Squares	F	Significance
Corrected Model	1627.860	3	542.620	6.873	.000
Intercept	8673.363	1	8673.363	109.858	.000
Group	663.935	2	331.968	4.205	.018*
Word Recognition	853.310	1	853.310	10.808	.001
Error	7973.988	101	78.950		
Total	20022.000	105			
Corrected Total	9601.848	104			

*Significant at the $p < .05$ level.

significant differences were found. The pairwise comparisons are presented in Table 19, and the adjusted group means for word recognition fluency are presented in Table 20.

Analysis of the Data for Testing Hypotheses 6 and 7

For Hypotheses 6 and 7, chi-square analyses were used to compare the frequency counts of specific groups. For Hypothesis 6, the number of students in each group who scored below the 30th percentile on measures collected at the end of kindergarten were compared. For Hypothesis 7,

Table 19

Pairwise Comparisons for Word Recognition Fluency

Group I	Group J	Mean Difference (I-J)	Standard Error	Significance
DI + PA	DI + PA			
	DI	2.947	2.164	.176
	CAI	6.208*	2.143	.005
DI	DI + PA	-2.947	2.164	.176
	DI			
	CAI	3.261	2.131	.129
CAI	DI + PA	-6.208*	2.143	.005
	DI	-2.947	2.164	.176
	CAI			

*Significant at the $p < .05$ level.

Table 20

Adjusted Group Means for Word Recognition Fluency

Group	Mean	Standard Error	N
DI + PA	13.101	1.549	33
DI	10.154	1.499	36
CAI	6.893	1.490	36

the scores of students who scored below the 30th percentile were examined to determine whether double-deficits in PA and rapid naming were manifested, either at the beginning or middle of kindergarten.

Frequency count by groups for scores below the 30th percentile. Chi-square tests were used to compare the frequency counts of students in each group who scored below the 30th percentile in Spring 2000 on measures of PA, phonological memory, and rapid naming. A second series of chi-square tests compared the number of students in each group who scored below the 30th percentile in Fall 2000 on measures of nonword and word reading fluency. The measures collected in Spring 2000 for the latter two measures could not be analyzed because most of the students were too young for their scores to be represented in the tables of standard scores. By fall, most of the students had reached 6 years of age, and their scores could be more accurately analyzed, so all subjects were retested at that time on nonword and word recognition fluency. No significant differences by group were found for the frequency of students scoring below the 30th percentile in any of the tested areas. The results of the chi-square tests are represented in Tables 21 through 25.

Frequency counts for students with double-deficits. A series of chi-square tests were used to address Hypothesis 7. The scores of students who scored below the 30th percentile in word and nonword reading fluency were examined to determine whether or not these students

Table 21

Comparison of Number of Students Scoring Below the 30th Percentile on Phonological Awareness in Spring 2000

	Treatment Group DI and PA		Comparison Group A DI		Comparison Group B CAI in PA	
	Count	Percent	Count	Percent	Count	Percent
> 30th Percentile	28	26.67	31	29.52	26	24.76
< 30th Percentile	5	4.76	5	4.76	10	9.53

Note. χ^2 (2, *N* = 105) = 2.726, *p* = .256

Table 22

Comparison of Students Scoring Below the 30th Percentile on Phonological Memory in Spring 2000

	Treatment Group DI and PA		Comparison Group A DI		Comparison Group B CAI in PA	
	Count	Percent	Count	Percent	Count	Percent
> 30th Percentile	25	23.81	28	26.67	25	23.81
< 30th Percentile	8	7.62	8	7.62	11	10.48

Note. χ^2 (2, *N* = 105) = 709, *p* = .702

Table 23

Comparison of Students Scoring Below the 30th Percentile on Rapid Naming in Spring 2000

	Treatment Group DI and PA		Comparison Group A DI		Comparison Group B CAI in PA	
	Count	Percent	Count	Percent	Count	Percent
> 30th Percentile	22	21.15	17	16.19	11	10.58
< 30th Percentile	10	9.62	16	15.38	13	12.50

Note. χ^2 (2, N = 104) =5.029, p = .081

Table 24

Comparison of Students Scoring Below the 30th Percentile on Word Recognition Fluency in Fall 2000

	Treatment Group DI and PA		Comparison Group A DI		Comparison Group B CAI in PA	
	Count	Percent	Count	Percent	Count	Percent
> 30th Percentile	20	21.3	17	18.1	11	11.7
< 30th Percentile	13	13.8	19	20.2	14	14.9

Note. χ^2 (2, N =94) = 1.914, p = .384

Table 25

Comparison of Students Scoring Below the 30th Percentile on Nonword Recognition Fluency in Fall 2000

	Treatment Group DI and PA		Comparison Group A DI		Comparison Group B CAI in PA	
	Count	Percent	Count	Percent	Count	Percent
> 30th Percentile	19	20.2	26	27.7	12	12.8
< 30th Percentile	14	14.9	10	10.6	13	13.8

Note. χ^2 (2, N =94) = 3.827, p = .148

evidenced a double-deficit in PA and rapid naming at either the beginning or middle of kindergarten. The number of students with a double-deficit scoring below the 30th percentile in word recognition fluency was significant for students whose double-deficit was detected in fall [χ^2 (1, N = 94) = 5.713, p = .017], or in winter [χ^2 (1, N = 87) = 10.607, p = .001]. The number of students with a double-deficit scoring below the 30th percentile in nonword recognition fluency was not significant for students whose double-deficit was detected in the fall of kindergarten [χ^2 (1, N = 94) = 3.374, p = .066], but did reach significance for students whose double-deficit was detected in the winter of kindergarten [χ^2 (1, N = 93) =

11.038, p = .001]. The results of these analyses are displayed in Tables 26 through 29.

Table 26

Comparison of Scores Below the 30th Percentile in Word Recognition Fluency in Fall 2000 to Double-Deficits in Fall 1999

	Double-Deficit in PA and RAN		No Double-Deficit in PA and RAN	
	Count	Percent	Count	Percent
> 30th Percentile	9	9.6	39	41.5
< 30th Percentile	19	20.2	22	28.7

Note. χ^2 (1, N =94) = 5.713, p = .017*

Table 27

Comparison of Scores Below the 30th Percentile in Word Recognition Fluency in Fall 2000 to Double-Deficit in Winter 2000

	Double-Deficit in PA and RAN		No Double-Deficit in PA and RAN	
	Count	Percent	Count	Percent
> 30th Percentile	2	2.3	45	51.7
< 30th Percentile	12	13.8	28	32.2

Note. χ^2 (1, N =87) = 10.607, p = .001*

Table 28

Comparison of Scores Below the 30th Percentile in Nonword Recognition Fluency in Fall 2000 to Double-Deficits in Fall 1999

	Double-Deficit in PA and RAN		No Double-Deficit in PA and RAN	
	Count	Percent	Count	Percent
> 30th Percentile	13	13.8	22	23.4
< 30th Percentile	15	16.0	44	46.8

Note. χ^2 (1, N =94) = 3.374, p = .066

Table 29

Comparison of Scores Below the 30th Percentile in Nonword Recognition Fluency in Fall 2000 to Double-Deficits in Winter 2000

	Double-Deficit in PA and RAN		No Double-Deficit in PA and RAN	
	Count	Percent	Count	Percent
> 30th Percentile	3	3.2	54	58.1
< 30th Percentile	11	11.8	25	26.9

Note. χ^2 (1, N = 93) = 11.038, p = .001

Analysis of the Data for the Testing of Hypotheses 8 Through 11

Data collected at the end of the first-grade-year were used to examine the long-term effects of the interventions in the kindergarten year. ANCOVAs or interaction models were used to compare group means on pre- and posttest data collected in the areas of nonword and word recognition fluency. In addition, text-reading fluency and comprehension scores for the group means of scores collected in the spring of first grade were compared using an ANOVA.

Nonword recognition fluency. Because all subjects scored 0 on the Fall 1999 pretest, the presence of an interaction between the treatment and covariant could not be determined. The data were analyzed using an ANOVA which revealed no significant treatment effect [F (2,89) = .189, p = .828] . The results for the comparison of the data collected in Fall 1999 and Spring 2001 are presented in Table 30.

Table 30

Summary of the Analysis of Variance for Nonword Recognition Fluency

Source	Type III Sum of Squares	Df	Mean Square	F	Significance
Corrected Model	94.479	2	47.239	.189	.828
Intercept	25458.128	1	26458.128	101.958	.000
Group	94.479	2	47.239	.189	.828
Error	22222.597	89	249.692		
Total	47995.000	92			
Corrected Total	22317.076	91			

Word recognition fluency. No significant interaction was found between the treatment and covariant [F (2,86) = .372, p = .690] , so the interaction term was removed and an ANCOVA was conducted. No treatment effect was found [F (2,88) = 1.208, p = .304] . The summary of the ANCOVA is reported in Table 31, and the parameter estimates are reported in Table 32.

Fluency. In the spring of the first-grade year, Spring 2001, a fluency measure was taken to examine group differences. An ANOVA revealed no significant differences, though the treatment group outperformed both comparison groups on this measure, and the differences approached significance. The ANOVA and the group means are reported in Tables 33 and 34.

Comprehension. A comprehension measure was also performed in the spring of the first-grade year to examine long-term differences in the groups. The ANOVA revealed differences in the group means that approached significance. Though no significant differences were detected, the mean group score of the treatment group was higher than that of either comparison group. The summary of the ANCOVA and group means appear in Tables 35 and 36.

Table 31

Summary of the Analysis of Covariance for Word Recognition Fluency

Source	Type III Sum of Squares	df	Mean Square	F	Significance
Corrected Model	2405.914	3	801.971	2.627	.055
Intercept	92983.812	1	92983.812	304.631	.000
Group	737.468	2	368.734	1.208	.304
Words	1702.762	1	1702.762	5.579	.020
Error	26860.640	88	305.235		
Total	136641.000	92			
Corrected Total	29266.554	91			

Table 32

Adjusted Group Means for Word Recognition Fluency

Group	Mean	Standard Error	N
DI + PA	6.628	4.700	31
DI	1.226	4.613	36
CAI	0		25

Table 33

Summary for the Analysis of Variance for Fluency Means

	Sum of Squares	df	Mean Square	F	Significance
Between Groups	10833.284	2	5416.642	3.305	.053
Within Groups	158864.46	89			
Total	169697.74	91			

Table 34

Group Means for Fluency

Group	N	Mean	Standard Deviation
DI + PA	31	75.10	43.98
DI	36	65.36	44.30
CAI in PA	25	47.32	36.61
Total	92	63.74	43.18

Table 35

Summary for the Analysis of Variance for Comprehension Means

	Sum of Squares	df	Mean Square	F	Significance
Between Groups	160.651	2	80.325	2.786	.067
Within Groups	2566.625	89	28.836		
Total	2727.076	91			

Table 36

Group Means for Comprehension

Group	N	Mean	Standard Deviation
DI + PA	31	7.90	5.44
DI	36	5.89	5.21
CAI in PA	25	4.56	5.52

Summary

The purpose of this study was to determine the effect of intensity of instruction in phonological awareness on the development of literacy skills in young children. In addition, the effect of an increase in intensity of PA instruction on the frequency of students placing below the 30th percentile in literacy skills, at the end of the kindergarten year, was examined. Further, the group placing below the 30th percentile was examined to determine the frequency of students in the group who manifested a double-deficit in PA and rapid naming, either at the beginning or middle of the kindergarten year. Finally, the long-term effect of increasing the intensity of classroom instruction in PA skills was investigated.

The group that received the most intense instruction in PA was the treatment group, which received a DI reading program with a supplemental PA program (2615 minutes in

PA). The group that received the second level of instruction in PA was the group that only received instruction in the DI reading program (1010 minutes in PA). The group receiving the least amount of instruction in PA was a group which received only computer-assisted instruction in PA (262 minutes in PA).

The data collected yielded significant results for the treatment group, when compared to the group which received computer-assisted instruction in PA, at the end of the kindergarten year, in the areas of rapid naming, nonword reading fluency, and word recognition fluency. No significant effect was found in the area of phonological memory. The effect of the treatment on PA could not be determined, as an ANOVA demonstrated preexisting differences between the groups in this area, and an ANCOVA revealed an interaction between the treatment and PA. No other significant differences were found in the group means at the end of kindergarten.

Chi-square tests showed no significant differences in the groups in the number of students scoring below the 30th percentile in the several areas tested. The areas examined included PA, phonological memory, rapid naming, nonword reading fluency, and word recognition fluency.

Additional chi-square measures compared students with a double-deficit in the areas of PA and rapid naming, at either the beginning or middle of kindergarten, to determine the frequency of such students scoring below the 30th percentile in nonword reading fluency or word recognition fluency at the beginning of first grade. Significant chi-square statistics were obtained for students with a double-deficit in PA and rapid naming, for measures collected at the beginning or middle of kindergarten, who scored below the 30th percentile in word recognition fluency. No significant statistics were obtained for students with a double-deficit at the beginning of kindergarten scoring below the 30th percentile in nonword reading fluency. However, the frequency differences in students scoring below the 30th percentile in nonword recognition fluency did reach significance for students evidencing a double-deficit at the middle of kindergarten.

The students were assessed again, at the end of the first grade year, to determine the long-term effects of treatment. Nonword reading fluency, word recognition fluency, reading fluency, and comprehension were examined. No significant differences in group means were detected, though the differences approached significance in both reading fluency and comprehension.

CHAPTER 5
DISCUSSION

As early as 1963 (Elkonin, 1963; Zhurova, 1963), researchers began to find evidence that, for most children, skill in phonological awareness is critical for learning to read. Since that time, amassing evidence has shown that not only is poor PA a source of serious reading disability (Fletcher et al., 1994; Morris et al., 1998; Shaywitz, 1996; Stanovich & Siegel, 1994), but also that instruction in PA accelerates reading growth (Lundberg et al., 1988; Schneider et al., 1999; Torgesen et al., 1992; Vellutino et al., 1996). Furthermore, researchers have found that to be most effective, instruction in PA should be combined with instruction in the alphabetic principle (Ball & Blachman, 1988, 1991; Byrne & Fielding-Barnsley, 1989,1993; Hatcher, et al., 1994; Williams, 1980) and that instruction in both areas should be explicit, or direct (Adams, 1990; Foorman et al., 1997; Grossen & Carnine, 1993).

Torgesen (2000) proposed that increasing the intensity in PA instruction might reduce the number of children who fail to learn to read. An increase in intensity has typically been provided through the addition of an individual or small group intervention. However, financial restraints often prohibit the hiring of the additional personnel needed to provide individual or small group tutorial programs. Therefore, this study investigated the effect of increasing intensity through the use of a class-wide intervention.

This chapter reviews the hypotheses of the study in light of the data reviewed in Chapter 4. Successive sections address the theoretical implications of the findings and review limitations of the study. Suggestions for future research also are provided.

Summary of Hypotheses and Results

Eleven hypotheses were formulated and tested at the .05 level of significance. The first five hypotheses related to the comparison of the group mean scores on preliteracy and literacy skills assessments at the beginning and end of kindergarten. Hypothesis 6 addressed the frequency of students from each group testing below the 30th percentile on literacy tests. Hypothesis 7 regarded the frequency of students testing below the 30th percentile who manifested a double-deficit in PA and rapid naming. Finally, Hypotheses 8 through 11 addressed the long-term group mean differences on literacy skills assessments.

H_1: There will be no statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on standardized measures of phonological awareness, including elision, blending, and sound matching.

An ANOVA revealed significant initial differences in the groups on phonological awareness, most likely due to the low pretest scores of Comparison Group B, the group that received computer-assisted instruction in PA. In addition, an Interaction Model analysis disclosed a treatment by covariate interaction. It appears, in examining the interaction graph, that the students in the CAI group who scored lowest at the beginning of the year in PA benefited most from this intervention. Students who had relatively higher initial scores benefited most from the DI and DI plus PA interventions.

It should also be noted that several outlying scores contributed to the interaction effect. The researcher made the decision not to remove the outlying scores from the analysis, as no aberrant reason could be determined for the scores. The null hypothesis could not be rejected based on the data collected in this study.

H_2: There will be no statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of phonological memory.

No significant differences in the mean scores of the treatment group and the two comparison groups were detected. Therefore, the null hypothesis could not be rejected.

H_3: There will be no statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of rapid naming.

An ANCOVA revealed significant differences in the groups. Pairwise comparisons indicated that the treatment group's mean gains were significantly higher than the CAI group's gains but not significantly higher than those of the DI group. Therefore, statistical analysis resulted in a rejection of the null hypothesis for rapid naming.

H_4: There will be no statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of nonword reading.

An ANOVA detected significant treatment effects for nonword reading fluency. Pairwise comparisons demonstrated significantly higher mean gains from pretest to posttest for the treatment group when compared to the CAI group but not when compared to the DI group. The gains of the DI group were not significantly higher than those of the CAI group. The statistical analysis resulted in a rejection of the null hypothesis.

H_5: There will be no statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of word reading.

A significant treatment effect was found when an ANCOVA was conducted to compare the group mean scores. Pairwise comparisons revealed that the treatment group attained significantly higher mean differences than the CAI group but not the DI group. No other significant differences were found. The statistical analysis resulted in a rejection of the null hypothesis.

H_6: There will be no statistically significant difference at the end of kindergarten in the frequency of children who test below the 30th percentile on any of the standardized measures used, between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness.

A series of chi-square tests found no significant differences in the frequency of students in each group scoring below the 30th percentile in PA, phonological memory, rapid naming, word recognition fluency, or nonword recognition fluency at the end of kindergarten. Therefore, the statistical analysis did not lead to a rejection of the null hypothesis.

H_7: Of the percentage of children who test below the 30th percentile on measures of word or nonword reading at the end of kindergarten, there will be no statistically significant difference in the frequency of students who evidenced a double-deficit in PA and rapid naming, either at the beginning or middle of kindergarten, and students who did not evidence a double-deficit in PA and rapid naming.

A chi-square test did not show a significant difference in the frequency of students who scored below the 30th percentile in nonword reading fluency between those who demonstrated or did not demonstrate a double-deficit in PA and rapid naming at the beginning of kindergarten. However, the chi-square statistic was significant for those who manifested a double-deficit at the middle of the kindergarten year.

A second series of chi-square tests indicated that significantly greater numbers of students with a double-deficit in PA and rapid naming scored below the 30th percentile in word recognition fluency than did students without a double-deficit. This finding was significant for students who evidenced a double-deficit at either the beginning or middle of kindergarten. Therefore, the statistical analysis resulted in the rejection of the null hypothesis.

H_8: There will be no long-term statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of nonword reading, administered a year after the end of treatment.

No significant differences were found between the groups on measures of nonword reading fluency taken at the end of first grade. Therefore, the null hypothesis could not be rejected.

H_9: There will be no long-term statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a standardized measure of word reading, administered a year after the end of treatment.

No significant differences between the groups were detected on measures of word reading fluency taken at the end of first grade. Therefore, there was a failure to reject the null hypothesis.

H_{10}: There will be no long-term statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a measure of oral reading fluency, administered a year after the end of treatment.

No significant differences between the groups were found on measures of oral reading fluency taken at the end of first grade. Therefore, there was a failure to reject the null hypothesis.

H_{11}: There will be no long-term statistically significant difference between students receiving a Direct Instruction reading program, students receiving a Direct Instruction reading program supplemented by phonological awareness training, and students receiving only computer-assisted training in phonological awareness on a measure of reading comprehension, administered a year after the end of treatment.

No significant differences in the groups were found on measures of reading comprehension taken at the end of first grade. Therefore, there was a failure to reject the null hypothesis.

Theoretical Implications

The premise of this study, that an increase in the intensity of training in phonological awareness would lead to an improvement in literacy skills, was based on several theoretical frameworks, each of which is a derivative of McClelland, Rumelhart, and Hinton's (1986) Parallel Distributed Processing Model. The model supposes that a strengthening of connections between units or concepts, such as phonology or orthography, represent learning. The connections can be strengthened through increased experience or repetition.

Seidenberg and McClelland (1989) and Bereiter (1991) concurred with the early work of McClelland et al. (1986). The researchers suggested that an increase in repetitions might be considered a higher level of intensity of instruction.

Adams (1990) expanded Seidenberg and McClelland's (1989) construct, which addressed only the orthographic and phonological processors, to include the entire reading process. Adams also stressed intensity as being critical to the development of automaticity. She stated that the overlearning of orthographic and phonological information leads skilled readers to rapidly and efficiently decode and recognize words.

Adams (1990) also agreed with the early research in PA (Elkonin, 1963; Zhurova 1963) in stating that it is the skill of PA that most frequently breaks down for struggling readers. She stated that problems in hearing the sounds of words make it difficult to map letters and sounds to their spoken equivalents and difficult to blend sounds to produce words.

Consistent with Adams' theory, Torgesen (2000) proposed that an increase in intensity of instruction might lead to an increase in literacy skills for struggling readers. Torgesen cautioned that, while we know that approaches which feature explicit, systematic instruction in PA and the alphabetic principle are necessary for optimal growth for students with phonological weaknesses, we do not yet know the amount of instruction or the conditions necessary for achieving this growth.

The findings of the present study are consistent with previous research. The treatment group, which received the greatest intensity in PA instruction (2615 minutes), showed the strongest gains at the end of the kindergarten year in rapid naming, word recognition fluency, and nonword recognition fluency. The adjusted group means showed the group which received the next level of intensity, the DI group (1010 minutes), showed greater, though not significantly greater, gains than the CAI group, which received the least instruction in PA (262 minutes), in the following areas: rapid naming, word recognition fluency, and nonword recognition fluency.

This study's results are also consistent with Rollanda O'Connor's findings (2000). She found that an increase in intensity produced an increase in achievement but that the learning rate was not sustained when the intensity decreased. O'Connor stated that "most of the children with disabilities and several others lost ground…when reading instruction retreated to the status quo" (p. 53). Similarly, the increased gains of the treatment group at the end of kindergarten were not evident a year after treatment had ceased. It may be that added support is necessary for even our most able readers to make increased gains.

When the groups were examined at the end of kindergarten, it was found that there was no significant difference in the groups in the frequency of students who scored below the 30th percentile in literacy skills. This arbitrary cutoff was chosen because it has been previously endorsed (Torgesen, 2000) as an acceptable standard of achievement. Children at or above the 30th percentile fall within .5 standard deviations of the mean. Therefore, use of this cutoff as a standard against which to measure the success of the intervention reflects an attempt to enable all children to achieve functional literacy skills. It is recognized that, by definition, 30% of the students will always fall at or below the 30th percentile. For this study, however, since one goal of treatment was to reduce the number of students who fell below an average range of achievement, the normed tests were used to gauge progress towards this goal, which was not achieved at a significant level.

However, the results from this segment of the study should be interpreted with caution. While there is no significant difference between groups in the number of students who fell below the 30th percentile in the tested literacy skills, there is still evidence of growth. The fact that there was no treatment by group interaction for rapid naming, word recognition fluency, or nonword recognition fluency, indicates steady growth, on average, across groups. Therefore, one might expect the treatment was effective at an average equivalent level for all students, and that the students in the below-average group made significant progress in these areas as did other students in the treatment group. However, it may be that our most struggling readers need even greater intensity than can be provided by a classwide intervention to attain the accelerated rate of growth necessary to reach an average range of achievement. They may benefit most from one-to-one or small group interventions.

The results of this study, which address students with a double-deficit, expand on the work of Wolf and Bowers (2000) in which the researchers proposed that students with a double-deficit in PA and rapid naming may be the most at risk of reading failure. The findings of this study confirm Wolf and Bowers' hypothesis in the area of word recognition fluency. Significantly greater numbers of students with a double-deficit did score below the 30th percentile in word recognition fluency than students without a double-deficit, whether the deficit was detected at the beginning or middle of kindergarten. However, it should be noted that 32% of the students with a double-deficit scored above the 30th percentile in this important literacy skill.

The findings of this study regarding nonword reading fluency are only partially consistent with Wolf and Bowers' (2000) suppositions. Students with a double-deficit did not score below the 30th percentile with significantly greater frequency than those without a double-deficit in PA and rapid naming, when the double-deficit was detected in the fall of kindergarten, but did score below the 30th percentile with significantly greater frequency when the double-deficit was detected in the middle of kindergarten. Torgesen (personal communication, October 29, 1998) theorized that kindergarteners are more accurately diagnosed in the winter than in the fall. Therefore, it may be the more accurate diagnosis that led to the significant difference in the group frequency when the diagnosis occurred later.

The implications of this study for special education are unmistakable. Students profit from greater intensity of instruction, even when delivered in a classwide model. Students with below-level reading achievement, though, may need additional small group or tutorial instruction to achieve the accelerated rate of growth necessary to reach adequate levels of literacy, as may students with a double-deficit in phonological awareness and rapid naming. Finally, there is an indication that increased intensity may be required for longer than a year if students are to maintain an accelerated rate of learning.

Limitations of the Study

This study had several important limitations. The most important is the fact that the treatment intervention occurred in a regular classroom setting. The typical interruptions in an elementary setting, such as special programs or holiday celebrations, may have interfered with the continuity of, and therefore the success of, the intervention. While attempts were made to ensure fidelity of treatment, such as observations of lesson implementation and teacher conferencing, the lack of daily consistency of treatment remains the strongest limitation of the study. In a tutorial setting the intervention may have been delivered with greater consistency, and the students may have achieved even greater success.

Limitations also involve geographical location and grade level. The study was conducted in north central Florida with kindergarten students. Therefore, the results should not be generalized to other sections of the country or to other grade levels.

Suggestions for Future Research

Clearly, much research needs to be conducted to determine the intensity and duration of treatment necessary to improve the literacy skills of our most struggling readers. Students with reading disabilities need to be specifically targeted to determine whether increased intensity of classroom instruction is beneficial for these students, or whether small group, or even one-to-one instruction is necessary to improve the reading skills of these students. The progress of these readers must be followed closely to determine whether type, intensity, or duration of treatment needs to be altered to maximize their progress.

In addition, interested researchers need to focus on the subtypes of reading disabilities. Is the same type of treatment, and the same intensity and duration of treatment, equally effective for students with a single deficit in PA or rapid naming as for students with a double-deficit in PA and rapid naming? Are students with a double-deficit truly more resistant to treatment than students with a single deficit, or do they just require a different type or duration of treatment? Should the treatment be focused on the deficit area; that is, should a student with only a deficit in rapid naming receive treatment in PA, or might fluency training be more appropriate?

In addition, research needs to be focused on the needs of older students. Much of the current research is aimed toward preschool through first-grade students. Older students with reading disabilities may require a different type, intensity, or duration of treatment than young students.

Summary

This study focused on the effect of an increase in intensity of instruction in PA on the acquisition of literacy skills of young children. In addition, the study investigated the frequency of students scoring below the 30th percentile in literacy skills for each of the groups. The study also investigated the frequency of students with a double-deficit in PA and rapid naming scoring below the 30th percentile in literacy skills. Finally, the study addressed the long-term effect of an increase of intensity of instruction in PA during the kindergarten year.

The findings of the study indicate that the treatment group, which received Direct Instruction in reading with a supplemental treatment in PA, attained significant mean gains in rapid naming, nonword, and word reading fluency when compared to the gains of a group receiving only computer-assisted instruction in PA. The gains of the treatment group were not significantly higher than those of the group receiving only Direct Instruction in reading. Nor were the mean gains of the DI group higher than those of the CAI group. The adjusted mean scores were highest for the treatment group in the areas of rapid naming, nonword recognition fluency, and word recognition fluency at the end of kindergarten. However, the significant differences were no longer detected at the end of first grade, a year after treatment had ceased.

No significant differences were found in the frequency of students in each group scoring below the 30th percentile on literacy skills. However, it is recognized that students in the treatment group, even in the below-average range, made significantly greater gains in rapid naming, word recognition fluency, and nonword recognition fluency than did those in the CAI group.

Significant differences in frequency were found in the number of students with a double-deficit in PA and rapid naming, who scored below the 30th percentile on word reading fluency, when compared with the number of students without a double-deficit. Significant differences were also found in the frequency of students with a double-deficit scoring below the 30th percentile in nonword reading fluency when the deficit was detected at the middle, but not at the beginning, of kindergarten.

From these findings, teachers should become aware that increasing the frequency of instruction in PA may result in an increase in literacy skills for many students. It should also be recognized that students with reading disabilities may require even more intensive instruction than can be provided in a class-wide setting if they are to attain the accelerated rates of progress necessary to attain adequate levels of literacy.

Teachers should also be aware that the intensity of instruction must be maintained for longer than a year for many students to achieve and maintain maximum growth in literacy skills. It may be that reading disabled students, and even some average and above-average students, may require an ongoing increase in intensity.

Researchers should address the types, duration, and intensity of instruction necessary to reach our most disabled readers. There is emerging evidence that students with a double-deficit in PA and rapid naming may need specialized treatment. This hypothesis needs to be directly addressed. Students who fail to make adequate progress must be addressed in the findings of each study if we are to determine the approaches necessary to teach every child to read.

APPENDIX A
PHONOLOGICAL AWARENESS ASSESSMENT

Subtest I. Elision

MATERIALS: None

CEILING: Stop after child misses 3 test items in a row.

FEEDBACK: Give feedback on all practice items and test items 1-5 only.

SCORING: Record correct answers as 1 and incorrect answers as 0. The total raw score for this subtest is the total number of correct test items up to the ceiling.

DIRECTIONS: Say, **"Let's play a word game."**

PRACTICE ITEMS:

a. **Say *toothbrush*. Now say *toothbrush* without saying *tooth*.**

If correct, say, **"That's right. Let's try the next one."**
If incorrect, say, **"That's not quite right. Toothbrush without saying tooth is brush."**

Continue to give correct/incorrect feedback as before. Say, **"Let's try some more."**

b. **Say *airplane*. Now say *airplane* without saying *plane*.**
c. **Say *doughnut*. Now say *doughnut* without saying dough.**

TEST ITEMS: Continue to give correct/incorrect feedback as before.

1. **Say popcorn. Now say *popcorn* without saying *corn*.**

2. **Say *baseball*. Now say *baseball* without saying *base*.**
3. **Say *spider*. Now say *spider* without saying *der*.**

PRACTICE ITEMS: Say, **"Okay, now let's try some where we take away smaller parts of the words."** Continue to give correct/incorrect feedback. Use the phoneme, not the letter name (e.g., /k/ is the sound of k).

b. **Say *cup*. Now say *cup* without saying */k/*.**
If correct say, **"That's right. Let's try the next one."**
If incorrect say, **"That's not quite right. Cup without saying /k/ is up."**
c. **Say *meet*. Now say *meet* without saying */t/*.**
d. **Say *farm*. Now say *farm* without saying */f/*.**

TEST ITEMS: Continue to give correct/incorrect feedback as before.

4. **Say *bold*. Now say *bold* without saying */b/*.**
5. **Say *mat*. Now say *mat* without saying */m/*.**

REMAINING TEST ITEMS: Provide no feedback on remaining items.

	Correct Response	**Score (1/0)**
6. **Say *tan*. Now say *tan* without saying */t/*.**	an	___
7. **Say *mike*. Now say *mike* without saying */k/*.**	my	___
8. **Say *time*. Now say *time* without saying */m/*.**	tie	___
9. **Say *tiger*. Now say *tiger* without saying */g/*.**	tire	___
10. **Say *powder*. Now say *powder* without saying */d/*.**	power	___
11. **Say *winter*. Now say *winter* without saying */t/*.**	winner	___
12. **Say *snail*. Now say *snail* without saying */n/*.**	sail	___
13. **Say *faster*. Now say *faster* without saying */s/*.**	fatter	___
14. **Say *sling*. Snow say *sling* without saying */l/*.**	sing	___

15. Say *driver*. Now say *driver* without saying */v/*.	dryer	___
16. Say *silk*. Now say *silk* without saying */l/*.	sick	___
17. Say *flame*. Now say *flame* without saying */f/*.	lame	___
18. Say *strain*. Now say *strain* without saying */r/*.	stain	___
19. Say *split*. Now say *split* without saying */p/*.	slit	___
20. Say *fixed*. Now say *fixed* without saying */k/*.	fist	___
	Total Raw Score	___

Subtest III. Blending Words

MATERIALS: Audiocassette recorder and "Blending Words" section of cassette

CEILING: Stop after child misses 3 test items in a row.

NOTE: If the child asks you to repeat the sounds, you may play the taped sounds one more time.

PROMPT: If the child says the sounds separately (e.g., m-e rather than *me*), prompt by saying, **"Try to say the sounds all together as a real word."** This prompt can be used as often as needed on practice words *only*.

FEEDBACK: Give feedback on all practice items and the *first 3 test items only*.

SCORING: Record correct answers as *1* and incorrect answers as *0*. The total raw score for this subtest is the total number of correct test items up to the ceiling.

DIRECTIONS

PRACTICE ITEMS: Say, **"Listen to the audiocassette recorder. You will hear some words in small parts, one part at a time. I want you to listen carefully, and then put these parts together to make a whole word. Ready? Let's try one."**

a. Play the taped instruction that says, "What word do these sounds make? Can-dy". Then pause to allow the child to answer.

If correct say, **"That's right. Let's try the next one."**

If incorrect say, **"That's not quite right. When you put *can-dy* together, it makes *candy*. You try it: *can-dy* makes ______?** (Pause.) **"Let's try the next one."**

Continue the taped items listed below, pausing after each item, and give corrective feedback as above.

		Corrective Response
b. What word do these sounds make?	ham-er	hammer
c. What word do these sounds make?	s-un	sun
d. What word do these sounds make?	t-ak	take
e. What word do these sounds make?	n-o	no
f. What word do these sounds make?	m-a-d	mad

TEST ITEMS: Say, **"Let's try some more words. Each time you will hear the word one part at a time. Listen carefully and put the parts together to make a whole word."** (Continue the taped items below, pausing after each item.) Items may be repeated once.

FEEDBACK on Items 1-3 only:
If correct say, **"That's right."**
If incorrect say, **"When you put num-ber together, it makes number."**

	Correct Response	**Score (1/0)**
1. num-ber	number	___
2. pen-sel	pencil	___
3. an-ser	answer	___
4. i-t	it	___
5. t-oi	toy	___
6. s-o	saw	___
7. sh-e	she	___
8. n-ap	nap	___
9. m-i-s	miss	___
10. b-o-n	bone	___
11. m-oo-n	moon	___
12. s-t-a-m-p	stamp	___
13. j-u-m-p	jump	___
14. m-i-s-t-a-k	mistake	___
15. s-ur-k-e-s	circus	___
16. o-l-m-o-s-t	almost	___
17. g-r-a-s-h-o-p-er	grasshopper	___
18. t-e-s-t-e-f-i	testify	___
19. u-n-d-er-s-t-a-n-d	understand	___
20. m-a-th-e-m-a-t-i-k-s	mathematics	___
	Total Raw Score	___

Subtest IV. Sound Matching

MATERIALS: Picture Book

CEILING: Stop when child misses 4 out of 7 test items (give at least 7 test items).

NOTE: Items can be repeated once if child appears to forget names given to pictures. For practice and test items, pause 1 second after pronouncing the target word before pronouncing the three alternative answers. Point to the pictures as their names are pronounced. Child may point to or say correct responses.

FEEDBACK: Give feedback on all practice items and the *first three test items only.*

SCORING: Record correct answers as 1 and incorrect answers as 0. The total raw score for this subtest is the total number of correct responses up to the ceiling.

PART 1-FIRST SOUND

DIRECTIONS

PRACTICE ITEMS: Open Picture Booklet to the example page for Subtest 4. Say, **"We're going to play a game with words. I will show you pictures to help you remember the words."**

a. **Look at the first picture. This is a sock. Now look at these two pictures. This is the sun and this is a bear. The word *sock* starts with the /s/ sound. Which of these picture words starts with the /s/ sound like sock: *sun* or *bear*?"** Point to the pictures as you say their names.

> If correct say, **"That's right; *sock* and *sun* start with the same sound, /s/. Let's try the next one."**
> If incorrect say, **"That's not quite right. The answer is *sun*, because *sock* and *sun* (emphasize the first sound) start with the same sound, /s/. Let's try another one."**

Continue correct/incorrect feedback as above; point to each picture as you say the names.

	Correct Response
b. **Which word starts with the /n/ sound like *neck*? *Nut, bed,* or *cake*?**	nut
c. **Which word starts with the same sound as *food*? *Bat, hook,* or fish?**	fish

TEST ITEMS: Point to each picture as you say the names. Provide feedback on Items 1-3 only.

If correct say, **"That's right. *Pan* and pig start with the same sound,/p/. Let's try the next one."**
If incorrect say, **"That's not quite right. The answer is *pig*, because pan and *pig* (emphasize the first sound) start with the same sound /*p*/. Let's try another one."**

	Correct Response	**Score (1/0)**
1. **Which word starts with the same sound as *pan*? *pig, hat*, or *cone*?**	pig	___
2. **Which word starts with the same sound as *duck*? *run, kick*, or *dice*?**	dice	___
3. **Which word starts with the same sound as *fan*? *fire, can*, or *sack*?**	fire	___
		Stop Feedback
4. **Which word starts with the same sound as *man*? *cat, fin*, or *mouse*?**	mouse	___
5. **Which word starts with the same sound as *love*? *dive, light*, or *tub*?**	light	___
6. **Which word starts with the same sound as *nap*? *tape, net*, or *man*?**	net	___
7. **Which word starts with the same sound as *cake*? *bike, coat*, or *game*?**	coat	___
8. **Which word starts with the same sound as *bag*? *bone, dad*, or *pig*?**	bone	___

9. **Which word starts with the same sound as *rain*? *tape, line*, or *rope*?**	rope	___
10. **Which word starts with the same sound as *house*? *mice, ham*, or *couch*?**	ham	___

Proceed to **Part 2** unless child reaches a ceiling on **Part 1** (misses 4 of 7 items).

PART 2-LAST SOUND

DIRECTIONS

PRACTICE ITEMS: Open Picture Booklet to the example page for this part. Say, **"We're going to change our word game."**

a. **Look at the first picture. This is a can. Look at these two pictures: pot and sun. The word can ends with the /n/ sound. Which of these words ends with the /n/ sound like *can*? *Pot* or *sun*?"** Point to the pictures as you say their names.

> If correct say, **"That's right. *Can* and *sun* end with the same sound, /n/. Let's try the next one."**
> If incorrect say, **"That's not quite right. The answer is *sun*, because *can* and *sun* (emphasize the last sound) end with the same sound, /n/. Let's try another one."**

Continue correct/incorrect feedback as above; point to each picture as you say the names.

	Correct Response
c. **Which word ends with the /m/ sound like *gum*? *goat, nut*, or *farm*?**	farm
d. **Which word ends with the same sound as *leg*? *leaf, rug*, or *pen*?**	rug

TEST ITEMS. Point to each picture as you say the names below. Provide feedback on Items 11-13 *only*.

> If correct say, **"That's right. *Hill* and *doll* end with the same sound, /l/. Let's try the next one."**
> If incorrect say, **"That's not quite right. The answer is *doll*, because *hill* and *doll* (emphasize the last sound) end with the same sound /l/. Let's try another one."**

	Correct Response	**Score (1/0)**
11. **Which word ends with the same sound as *hill*? *doll, hat* or *whip*?**	doll	___
12. **Which word ends with the**	lip	___

same sound as cap? *car, lip,* or *fan*?		
13. **Which word ends with the same sound as *dog*? *dime, pot,* or *pig*?**	pig	___
		Stop Feedback
14. **Which word ends with the same sound as *cat*? *sit, comb,* or *back*?**	sit	___
15. **Which word ends with the same sound as *rob*? *knot, rain,* or tub?**	tub	___
16. **Which word ends with the same sound as *pin*? *pot, bone,* or *rib*?**	bone	___
17. **Which word ends with the same sound as *lid*? *bed, light,* or *pig*?**	bed	___
18. **Which word ends with the same sound as *sack*? *bat, kick,* or *soap*?**	kick	___
19, **Which word ends with the same sound as *face*? *cake, fish* or *mice*?**	mice	___
20, **Which word ends with the same sound as *leaf*? *line, knife* or *teeth*?**	knife	___

Total Raw Score ___

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APPENDIX B
PHONOLOGICAL MEMORY ASSESSMENT

Subtest VI. Memory for Digits

MATERIALS: Audiocassette recorder and "Memory for Digits" section of cassette.

CEILING: Stop after child misses 4 test trials in a row.

FEEDBACK: If the child makes an error, supply the correct answer only on the practice items.

NOTE: Record the child's complete response to the right of the item on the response sheet. If the child wants a trial repeated, say you are not allowed to repeat the numbers.

SCORING: Score 1 point for each test trial completed without error.

DIRECTIONS: Say, **"On this one, you will hear some numbers, one after another on the audiocassette recorder. After you hear the numbers, I want you to say them in the same order that you heard them. Listen carefully because I can't repeat the numbers. Let's try a couple for practice."** Start the cassette, pausing after each trial to allow the child to respond. (Note: Try to keep your finger on or near the pause button so that the hand movement does not result in anticipation of the end of trial.) Do the practice series. If the child makes an error on the practice series, supply the correct answer.

PRACTICE ITEMS:

a. 5 2
b. 7 3
c. 9 7 1
d. 6 1 5 Stop Feedback

TEST ITEMS: Say, **"Okay, now let's do some more. Just listen carefully, and do your best."**

	Score (1/0)		**Response**
1.	______	1 6	__________
2.	______	7 2	__________
3.	______	9 4	__________
4.	______	6 1 2	__________
5.	______	6 4 8	__________
6.	______	3 8 6	__________
7.	______	6 1 5 8	__________
8.	______	3 4 1 7	__________
9.	______	7 5 9 6	__________
10.	______	4 1 8 3 9	__________
11.	______	5 2 1 8 6	__________
12.	______	8 4 2 3 9	__________
13.	______	3 8 9 1 7 4	__________
14.	______	6 4 1 3 9 7	__________
15.	______	7 9 6 4 8 3	__________
16.	______	3 1 9 7 4 2 6	__________
17.	______	9 8 5 2 1 6 3	__________
18.	______	5 1 7 4 2 3 8	__________
19.	______	4 6 3 5 9 2 7 1	__________
20.	______	2 9 7 6 3 1 5 4	__________
21.	______	1 6 4 5 9 7 6 3	__________
	______	**Total Raw Score**	

Subtest VII. Nonword Repetition

MATERIALS: Audiocassette recorder and "Nonword Repetition" section of cassette.

CEILING: Stop after child misses 3 test items in a row.

FEEDBACK: Give feedback on all practice items and the first 3 test items.

NOTE: If child asks to have an item repeated say, **"I can only play the taped sounds once."**

SCORING: Record correct answers as *1* and incorrect answers as *0*. The total raw score for the subtest is the total number of correct responses up to the ceiling.

DIRECTIONS

PRACTICE ITEMS: Say, **"I want you to listen to some made-up words on the audiocassette recorder. After you hear each made-up word, I want you to say it exactly as you heard it and as clearly as you can. Even if it's hard to say, give it your best try. Listen carefully because I can't repeat the words. Okay? Let's try some."** Start cassette.

FEEDBACK on Items 1-3 only.

> If correct say, **"That's right."**
> If incorrect say, **"Good try. The word was _____."**

TEST ITEMS	**Score (1/0)**
1. jup	_____
2. zid	_____
3. pate	_____

Stop Feedback

---

4. meb	_____
5. wudoip	_____
6. nigong	_____
7. chaseedoolid	_____
	_____

8. bieleedoge ______
9. voesutoov ______
10. lisashrul ______
11. wulanuwup ______
12. teebudeshawlt ______
13. viversoomou ______
14. burloogugendaplo ______
15. gekleziesaedad ______
16. mawgeebooshernooshiek ______
17. dookershatupietazawm ______
18. shaburiehuvoimush ______

Total Raw Score ______

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APPENDIX C
RAPID NAMING ASSESSMENT

Subtest II. Rapid Color Naming

MATERIALS: Stopwatch, color naming pages in Picture Book (Practice, Forms A and B)

CEILING: Discontinue testing if on the practice items the child cannot name all of the colors correctly after error correction. If the child makes more than 4 errors on Form A, discontinue testing at that point. If the child makes more than 4 errors on either form, do not score subtest.

Scoring: The score for the subtest is the number of seconds that it takes the examinee to name all of the colors on Form A and Form B combined. Items are marked incorrect if the child skips the color or gives the wrong name. If the child skips a line, score the first color on the skipped line as incorrect and try to redirect the child to the correct line. If the child hesitates for more than 2 seconds on a color, mark it as incorrect and point to the next item and say, **"Go on."**

DIRECTIONS

PRACTICE ITEMS: Show practice pages and say, **"What colors do you see on this page?"** (Point to the first color and continue pointing if necessary. If the child makes any errors, correct the child, and have him or her repeat all the colors again. If the child continues to make errors, discontinue testing.) Say, **"You will be saying the names of some colors as fast as you can."**

TEST ITEMS: Say, **"Now I want you to say the names of the colors on this page as fast as you can. When I tell you to start, you will begin here** (point to upper left corner on Form A), **and name this row** (point to top row) **before you go**

on to the next row. Just name the colors in each row as fast as you can until you come to the end. Try not to skip any boxes. Do you understand?"

Put a blank sheet on top of Form A to cover the colors for about 5 seconds. Say, **"You will begin as soon as I uncover the page. Ready? Begin."**

Quickly take cover off the page, and start timing as soon as the child says the first color name. Stop timing when the name of the last color is pronounced. Keep track of errors by putting a slash through each wrong item. When the child is finished, record time and errors. Continue with Form B unless the child made more than 4 errors on Form A.

Form A:

Blue	Red	Green	Black	Brown	Yellow	Red	Black	Blue
Yellow	Green	Brown	Blue	Red	Green	Black	Yellow	Brown
Green	Yellow	Black	Red	Brown	Blue	Green	Red	Blue
Black	Brown	Yellow	Brown	Green	Red	Yellow	Blue	Black

Time ____

Errors ____

Form B: After colors on Form A are completed, open to Form B and say, **"Now we will do it one more time. Remember, say the colors as fast as you can."** (Follow the same procedure as for Form A.)

Black	Blue	Yellow	Red	Green	Brown	Yellow	Brown	Black
Blue	Red	Green	Blue	Brown	Red	Black	Yellow	Green
Brown	Yellow	Black	Green	Red	Blue	Brown	Green	Yellow
Blue	Black	Red	Yellow	Brown	Black	Green	Red	Blue

Time ____

Errors ____

Subtest V. Rapid Object Naming

MATERIALS: Stopwatch, object naming pages in Picture Book (Practice, Forms A and B)

CEILING: Discontinue testing if on the practice items the child cannot name all of the objects correctly, even after error correction. If the child makes more than 4 errors on Form A, do not give Form B. If the child makes more than 4 errors on either form, do not score the subtest.

SCORING: The score for this subtest is the number of seconds that it takes the examinee to name all of the objects on Form A and Form B combined. Items are marked incorrect if the child skips the object or gives it the wrong name. If the child skips a line, score the first object on the skipped line as incorrect and try to redirect the child to the correct line. If the child hesitates for more than 2 seconds on an object, mark it as incorrect and point to the next item and say, **"Go on."**

DIRECTIONS

PRACTICE ITEMS: Show practice page and say, "What objects do you see on this page?" (Point to first object and continue pointing if necessary. If the child makes any errors, correct the child, and have him or her repeat all the objects again. If the child continues to make errors, discontinue testing.) Say, **"You will be saying the names of some objects as fast as you can."**

TEST ITEMS: Say, **"Now I want you to say the names of the objects on this page as fast as you can. When I tell you to start, you will begin here** (point to upper left corner on Form A), **and name this row** (point to top row) **before you go on to the next row. Just name the objects in each row as fast as you can until you come to the end. Try not to skip any objects. Do you understand?"**

Put a blank sheet on top of Form A to cover the objects for about 5 seconds. Say, **"You will begin as soon as I uncover the page. Ready? Begin."**

Quickly take cover off the page, and start timing as soon as the child says the first object's name. Stop timing when the name of the last object is pronounced. Keep track of errors by putting a slash through each wrong item. When the child is finished, record time and errors. Continue with Form B unless the child made more than 4 errors on Form A.

Form A:

Pencil	Star	Fish	Chair	Boat	Key	Star	Pencil	Key
Fish	Boat	Chair	Key	Chair	Star	Boat	Fish	Pencil
Star	Chair	Key	Pencil	Fish	Boat	Star	Key	Fish
Chair	Boat	Pencil	Fish	Key	Chair	Pencil	Star	Boat

Time: ______

Errors: ______

Form B: After items on Form A are completed, open to Form B and say, **"Now we will do it one more time. Remember, say the objects as fast as you can."** (Follow the same procedure as for Form A.)

Boat	Star	Pencil	Chair	Key	Fish	Pencil	Boat	Chair
Fish	Key	Star	Boat	Fish	Pencil	Key	Chair	Star
Pencil	Fish	Boat	Star	Chair	Key	Chair	Boat	Fish
Key	Pencil	Star	Key	Boat	Chair	Fish	Star	Pencil

Time: ______

Errors: ______

Score ________ **(Time for Form A + Form B)**

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APPENDIX D
ASSESSMENT OF SIGHT WORD READING EFFICIENCY

Subtest I
Sight Word Reading Efficiency

MATERIALS: Stopwatch, Forms A and B Sight Word Efficiency Reading Cards

CEILING: Administer all items

SCORING: Mark all the words the examinee reads incorrectly and draw a line after the last word read. The examinee's raw score is the total number of words correctly read within 45 seconds. If the examinee finishes all the words before the time is up, note the time required to read all of the words. If the examinee skips a word, simply count it as an error. If he or she hesitates for more than 3 seconds on a word and is instructed to go to the next word, mark the word as incorrect.

PRACTICE: Present the Practice Words on the Form A card. Say, **"I want you to read some lists of words as fast as you can. Let's start with this practice list. Begin at the top, and read down the list as fast as you can. If you come to a word you cannot read, just skip it and go to the next word. Use your finger to help you keep your place if you want to."** Have the examinee read the words. If the examinee skips around a lot, ask him or her to read the words from top to bottom, without jumping around.

NOTE: If you are giving Form A immediately after Form B, omit the practice instructions and proceed Form A by saying, **"Now we will do it one more time. Remember to read the words as fast as you can without making errors. Skip any words you cannot read."**

PRACTICE WORDS: on, my, bee, old, warm, bone, most, spell

TEST: (Give the following instructions suing Form B to demonstrate.) Say, **"Okay, now you will read some longer**

lists of words. The words start out pretty easy, but they get harder as you go along. Read as many words as fast as you can until I tell you to stop. Begin here (point to the upper left corner on Form B) **and read down this list** (draw finger down the list) **before you start on the next list** (point to top of second column). **Read the words in order, but if you come to one you can't read, skip it and go to the next one. Use your finger to keep your place if you want to, and if you skip more than one word, point to the word you are reading next. Do you understand? Okay, you will begin as soon as I turn over the card."**

Quickly turn over the Form A card and start timing as soon as the examinee says the first word. As he or she is reading, mark any words that are misread or skipped. After 45 seconds, tell the examinee to stop, and note the last word read. If the examinee finishes all the words before the time is up, note the time required to read all the words. If, before the time is up, the examinee indicates that he or she cannot read any more words, ask the examinee to look over the whole list to see if there are any more words he or she can read. If the examinee then indicates he or she can read no more words, stop testing.

1. is
2. up
3. cat
4. red
5. me
6. to
7. no
8. we
9. he
10. the
11. and
12. yes
13. of
14. gun
15. as
16. book
17. was
18. help
19. then
20. time
21. wood
22. let
23. men
24. baby
25. new
26. stop
27. work
28. jump
29. part
30. fast
31. fine
32. milk
33. back
34. lost
35. find
36. paper
37. open
38. kind
39. able
40. shoes
41. money
42. great
43. father
44. river
45. space
46. short
47. left
48. people
49. almost
50. waves
51. child
52. strong
53. crowd
54. better
55. inside
56. plane
57. pretty
58. famous
59. children
60. without
61. finally
62. strange
63. budget
64. repress
65. contain
66. justice
67. morning
68. resolve
69. describe
70. garment
71. business
72. qualify
73. potent
74. collapse
75. elements
76. pioneer
77. remember
78. dangerous
79. uniform
80. necessary
81. problems
82. absentee
83. advertise
84. pleasant
85. property
86. distress
87. information
88. recession
89. understand
90. emphasis
91. confident
92. intuition
93. boisterous
94. plausible
95. courageous
96. alienate
97. extinguish
98. prairie
99. limousine
100. valentine
101. detective
102. recently
103. instruction
104. transient

Number of words read correctly. ____
If examinee finishes list before 45 seconds, note time to finish. ____

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APPENDIX E
ASSESSMENT OF PHONEMIC DECODING EFFICIENCY

Subtest II
Phonemic Decoding Efficiency

MATERIALS: Stopwatch, Forms A and B Phonemic Decoding Efficiency Reading Cards

CEILING: Administer all items

SCORING: Mark all the nonwords the examinee reads incorrectly on each form and draw a line after the examinee's last nonword. The examinee's raw score is the total number of nonwords read correctly within 45 seconds. If the examinee skips a nonword, simply count it as an error. If the examinee hesitates for more than 3 seconds on a nonword, mark it as incorrect and point to the next item and say, **"Go on."** Some items have more than one correct pronunciation for the vowel. Score the item correct if the examinee gives any of the correct pronunciations. Alternative correct pronunciations are indicated with real word examples, with the vowel in question underlined. For words with more than two syllables, alternative pronunciations are given separately for each syllable.

PRACTICE: Present the Practice Items on the Form A card. Say, **"Now I want you to read some words that are not real words. Just tell me how they sound. I want you to read them as fast as you can. Let's start with this practice list. Begin at the top, and read down the list as fast as you can. If you come to a made-up word you cannot read, just skip it and go to the next word. Use your finger to keep your place if you want to."** Have the examinee read the nonwords. If the examinee skips around a lot, ask him or her to read the words from top to bottom, without jumping around. If the examinee tries to substitute real words for the nonwords, remind him or her that these are made-up words, not real words, and the goal is to try to say how they sound.

NOTE: If you are giving Form A immediately after Form B, skip the practice instructions and proceed by saying, **"Now we will do it one more time. Remember to read the nonwords as fast as you can without making errors. Skip any nonwords you cannot read."**

PRACTICE WORDS: ba (bat, fate, pizza), um (umpire), fos (fossil), gan (gander), rup (rupture), nasp (clasp), luddy (muddy), dord (ford).

DIRECTIONS: (Give the following instructions using Form B to demonstrate.) Say, **"Now you will read some longer lists of nonwords. The words start out pretty easy, but they get harder as you go along. Just read as many of these nonwords as fast as you can until I tell you to stop. Begin up here (point to the upper left corner on Form B) and read words in order, but if you come to one you can't read, just skip it and go to the next one. Use your finger to keep your place if you want to, and if you skip more than one word, point to the word you are reading next. Do you understand? Okay, you will begin as soon as I turn over the card."**

Quickly turn over the Form A card and start timing as soon as the examinee says the first nonword. As the examinee is reading, mark all the words that are misread or skipped. After 45 seconds, tell the examinee to stop, and note the last word read. The examinee's score is the total number of words correctly read within 45 seconds. If the examinee finishes all the nonwords before the time is up, note the time required to read all the words. If, before the time is up, the examinee indicates that he or she cannot read any more words, ask the examinee to look over the whole list to see if there are any more words he or she can read. If the examinee then indicates he or she can read no more words, stop testing.

Stimulus	**Pronunciation**
1. ip	(tip)
2. ga	(gap, gate)
3. ko	(code, cot)
4. ta	(tack, tape)
5. om	(on)
6. ig	(pig)
7. ni	(nip, nice)

8.	pim	(him)
9.	wum	(sum)
10.	lat	(fat)
11.	baf	(bat)
12.	din	(pin)
13.	num	(cup)
14.	fet	(met)
15.	bave	(save)
16.	pate	(fate)
17.	herm	(term)
18.	dess	(mess)
19.	chur	(blur)
20.	knap	(nap)
21.	tive	(hive)
22.	barp	(tarp)
23.	stip	(tip)
24.	plin	(fin)
25.	frip	(trip)
26.	poth	(moth)
27.	vasp	(clasp)
28.	meest	(feast)
29.	shlee	(flee)
30.	guddy	(muddy)
31.	skree	(tree)
32.	guddy	(muddy)
33.	clirt	(shirt)
34.	sline	(line)
35.	dreef	(reef)
36.	prain	(pain)
37.	zint	(lint)
38.	bloot	(loot, book)
39.	trisk	(brisk)
40.	kelm	(helm)
41.	strone	(stone)
42.	lunaf	lu(tune, bun),naf(after)
43.	cratty	(fatty)
44.	trober	(sober)
45.	depate	de(dee, deck), pate (fate)
46.	glant	plant
47.	sploosh	(loose, book)
48.	dreker	dre (met, meet), ker (her)

49. ritlun	rit(sit), lun(bun)
50. hedfert	hed(bed), fert(fern)
51. bremick	bre(tree, bed), mick(tick)
52. nifpate	nif(sniff), pate(late)
53. brinbert	brin(fin), bert(her)
54. clabom	cla(clay, clap), bom(bomb)
55. drepnort	drep(pep), nort(fort)
56. shratted	(matted)
57. plofent	plo(toe, mop), fent(bent)
58. smuncrit	smun(fun), crit(bit)
59. pelnador	pel(fell), na(nap, nut, hip), dor(for, fur)
60. fornalask	forn(born), a(at,it,up), lask(task)
61. fermabalt	ferm(firm), a(at,it,up), balt (malt,bat)
62. credidmoke	cre(hen,see), nid(lid,up), moke(hope)
63. emulbatate	e(eel, or egg), mul(hull), ba(bat,bit,but), tate(late)

Number of words read correctly _____

If examinee finishes before 45 seconds,
note time to finish _____

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APPENDIX F
FLUENCY AND COMPREHENSION ASSESSMENT

Instructions for Administration of the QRI-II

Record:

- Correct words per minute
- Comprehension Points

For Fluency Measure:

- Ask the child to read the story. Say, "I'll ask you to tell me the story when you've finished reading."
- Begin with the title.
- Slash skipped or incorrect words.
- Draw a vertical line after 1 minute.
- Discontinue reading if the child has less than 30 correct words in a minute.
- Subtract errors from words read. The result is recorded as Correct Words per Minute.

Reading Error Rules:

- DON'T supply unknown words after 3 sec. Just encourage child to continue. Supplying the word affects the comprehension score.
- Self-corrections are not errors.
- Skipped words are errors.
- If a whole line is skipped, every word in the line is an error.

For Comprehension Measure:

- If the child reads the remainder of the story, say "Pretend I couldn't hear you read. Tell me everything you remember from the story."
- After the child has finished telling the story, ask, "Can you tell me anything else from the story?" Ask only once.
- Count retell items as the comprehension score.

The Bear and the Rabbit

Once there was a very big bear.
He lived in the woods.
He was sad because he didn't have anyone to play with.
He said to his father, "How can I find a friend?"
His father said, "By being you."
"But all the animals are afraid of me," said the bear.
"I can't even get near them."
But one day the bear was sitting by a river.
He was singing softly to himself.
A rabbit lived near the river.
He looked out of his hole when he heard the bear's song.
He thought, "Anyone who sings like that must be nice.
Maybe I don't need to be afraid of him.
It would be nice to have a friend."
The rabbit went and got his horn.
Very softly he began to play.
His music went well with the bear's song.
The bear looked around.
He couldn't see the rabbit.
Slowly, the rabbit walked up to the bear.
He kept playing and the bear kept singing.
They were both happy that they had found a friend.
And a bird joined in the song.

Retelling Scoring Sheet for The Bear and The Rabbit

Setting/Background

_____ There was a bear.
_____ who was big.
_____ He was sad
_____ because he didn't have anyone
_____ to play with.

Goal

_____ He asked his father
_____ "How can I find a friend?"

Events

_____ His father said
_____ "By being you."
_____ "But all the animals are afraid of me,"
_____ he said.
_____ The bear was sitting
_____ by the river.
_____ He was singing
_____ softly.
_____ A rabbit lived there.
_____ He looked out
_____ of his hole
_____ when he heard the song.
_____ He thought
_____ the bear was nice.
_____ The rabbit went
_____ and got his horn.
_____ He began to play.
_____ His music went well
_____ with the bear's song.
_____ The rabbit walked to the bear.
_____ The bear kept singing.

Resolution

_____ They were both happy
_____ that they had found a friend.
_____ A bird joined in.

Other ideas recalled including inferences:

Note. From Qualitative Reading Inventory, (p.130-132), by L. Leslie and J. Caldwell, 1995. New York: HarperCollins. Copyright 1995 by HarperCollins. Reprinted with permission.

APPENDIX G
SAMPLE DIRECT INSTRUCTION LESSON SEGMENTS

Reading Mastery I
Lesson 7, Tasks 11 and 12

TASK 11 Children say the words slowly.

a. **I'm going to say some words slowly, without stopping. Then you'll say them with me. First I'll say** (pause) ***zoo* slowly. Listen.** Hold up a finger for each sound. Do not stop between sounds. ***Zzzoooooo.* Now I'll say** (pause) ***we* slowly. Listen. Hold up a finger for each sound. *Wwweee.* Now I'll say** (pause) **in slowly. Listen.** Hold up a finger for each sound. ***Iiinnn*.**

b. **Now it's your turn to say the words slowly with me. Take a deep breath and we'll say (pause)** ***zzzoooooo*. Get ready.** Hold up a finger for each sound. Do not stop between the sounds. Say *zzzoooooo* with the children. ***ZZZoooooo*.**

To correct

If a child stops between the sounds, says the wrong sounds, or says the word fast:

1. **Listen.** Hold up a finger for each sound. Do not stop between the sounds. ***Zzzoooooo*.**
2. **Listen again.** Hold up a finger for each sound. ***Zzzoooooo*.**
3. **Say it with me. Get ready.** Hold up a finger for each sound. Say zzzoooooo with the children. ***Zzzoooooo*.**
4. **All by yourselves. Get ready.** Hold up a finger for each sound. ***Zzzoooooo*.**
5. Repeat 4 until firm.
6. Repeat *b*.

Now we'll say (pause) *wwweee*. Get ready. Hold up a finger for each sound. Say *wwweee* with the children. ***Wwweee*.**

Now we'll say (pause) *iiinnn*. Get ready. Hold up a finger for each sound. Say *iiinnn* with the children. ***Iiinnn*.**

- **c.** **Your turn to say the words slowly by yourselves. Say** (pause) ***zzzoooooo*. Get ready.** Hold up a finger for each sound. ***Zzzoooooo*.**
- **d.** **Again. Get ready. Hold up a finger for each sound. *Zzzoooooo*.**
- **e.** Repeat *d* until firm.
- **f.** **Say** (pause) ***wwweee*. Get ready.** Hold up a finger for each sound. ***Wwweee*.**
- **g.** **Again. Get ready.** Hold up a finger for each sound. ***Wwweee*.**
- **h.** Repeat *g* until firm.
- **i.** **Say** (pause) ***iiinnn*. Get ready.** Hold up a finger for each sound. ***Iiinnn*.**
- **j.** **Again. Get ready.** Hold up a finger for each sound. ***Iiinn*.**
- **k.** Repeat *j* until firm.
- **l.** Repeat *c* through *k* until firm.
- **m.** Call on different children. Each child does one word from *c, f,* or *i*.
- **n.** **Good saying the words slowly.**

SAY IT FAST

TASK 12 Children say the words fast.

- **a.** **Let's play Say It Fast.**
- **b.** Hold out your hand. **Listen. *Ooonnn*. Say it fast. *Ooonnn*. Say it fast.** Drop your hand. On. **Yes *on*.**
- **c.** **New word. Hold out your hand. Listen. *Nnnooozzz*. Say it fast.** Drop your hand. Nose. **Yes, *nose*.**
- **d.** Repeat *b* and *c* until firm.
- **e.** Call on different children to do *b* or *c*.

Note. From Reading Mastery I, (p.44), by S. Engelmann and E.C. Bruner, 1995. Worthington, Ohio: SRA Macmillan/McGraw-Hill. Copyright 1999 by SRA Division of Macmillan/McGraw-Hill. Reprinted with permission.

Reading Mastery I
Lesson 8, Task 6

SAY IT FAST

Task 6 Children say it fast

a. **Let's play Say It Fast.**
b. Hold out your hand. **Listen. Base** (pause) **ball. (Pause.) Say it fast!** Drop your hand. Baseball. **Yes, baseball.**
c. **Here's another word.** Hold out your hand. **Listen. Taaabllle.** (Pause.) **Say it fast!** Drop your hand. Table. **Yes, table.**
d. Repeat *b* and *c* until firm.

Note. From Reading Mastery I, (p.48), by S. Engelmann and E.C. Bruner, 1995. Worthington, Ohio: SRA Macmillan/McGraw-Hill. Copyright 1999 by SRA Division of MacMillan/McGraw-Hill. Reprinted with permission.

APPENDIX H
SAMPLE PHONOLOGICAL AWARENESS SUPPLEMENTAL LESSON

Lesson 8A

Two-Sound Words

Objective: To introduce the children to the challenges of analyzing syllables into phonemes and of synthesizing syllables from phonemes.

Materials Needed
Blocks
Two-phoneme word cards

Activity The two-sound games serve to introduce the procedure and logic of the more difficult phonemic analysis and synthesis activities that follow. In addition, two-sound words provide an unfettered medium for giving children practice with the sounds of the various phonemes, both in isolation and as blended together in phonologically minimal words. In view of this, it is more helpful to revisit them as needed by individuals or by the group than to dwell too long in any given session. Because of their foundational importance, however, it is critical that every child grasp this concept before moving on to the more advanced activities.

On the first day, it is sufficient to do analysis only. On subsequent days, begin with analysis and shift to synthesis. Similarly, for the first few days, it is wise to separate play with initial consonant words from play with final consonant words for clarity. Once the children have caught on, the two types of words should be freely intermixed. Finally, because the short vowels are so much more variable and less distinctive in both sound and articulation, their introduction should be deferred until the children are reasonably comfortable with long-vowel words. Again, to clarify the children's image of the phonemes and to support their ability to distinguish them one from another, it is valuable to ask them to feel how their mouths change position with each sound or to look at their mouths in a mirror while saying the words. In addition, as in all of the phonemic awareness activities, it is important to ensure that the students are familiar with each word used in these exercises. If you suspect that any of your students are not, it is wise to review the word's meaning and usage.

Note: To play these games, each of the children should have two blocks. In addition, you should have two blocks of your own and a set of pictures of two-phoneme words. Also, before beginning, it is important to have read the introduction to this chapter.

Analysis A child picks a card and names what it depicts. For this example, let us assume that the child chooses a picture of a hair bow. You would repeat the word, but slowly and with a clear pause (about a half-second interval) between its two phonemes (e.g., "*b…o*"). Then all of the children should repeat the word in this same manner, "*b…o…*" To show that the word bow consists of two separate sounds, the teacher now places blocks in two different colors underneath the picture as she enunciates the sound represented by each.

The children then repeat the word sound by sound while representing the sounds of the word, left to right, with their own blocks. The children should repeat the sounds while pointing to the respective blocks and then the word, pausing slightly less between phonemes with each repetition (e.g., "*b. . . o. . . , bow, b. . o..bow, b..o, bow, b-o. . .bow*").

Synthesis This game is just the reverse of the analysis game and likewise requires that you model the procedure before turning it over to the children. Choose a picture and place it face down so the children cannot see it. Then name the picture, phoneme by phoneme (e.g., "*b…o*"), while placing the blocks beneath the picture.

While pointing to their own blocks, the children must repeat the phonemes over and over and faster and faster as they did in the analysis game. When they believe they know the identity of the picture, they should raise their hands. The teacher may then ask the group or any individual to name the picture. After resolving any disagreements, the picture is held up for all to see.

After modeling several words in this way, pass the challenge to the children. For each new picture, help them agree on its name and give them time to analyze it on their own. To gain a good sense of who is and is not catching on, ask one or more individuals to share his or her solution to each word. Then the whole group should repeat the solution together, voicing the separate phonemes of the word as they point to their corresponding blocks.

Variations • Extend the exercises to unpictured words. At the outset of each analysis challenge, be sure to use each in a sentence for the sake of clarity (e.g., "Chew. Please *chew* your food before you swallow it. Chew."). Similarly, ask the children to use each word in a sentence as part of the wrap-up of each synthesis challenge.

• Later, this game can be used to teach the alphabetic principle by replacing the colored blocks with letter tokens. If you choose to do so, however, bear in mind that to convey the essential logic of the alphabetic principle, it is best that all words include one letter for each sound, left to right. With this in mind, avoid words with silent letters or digraphs. Use only short vowel words and, among those, only those that are spelled with two letters (e.g., *in* and *am* are fine, but not *edge* or *itch*).

Note: All of the words in the following lists consist of only two phonemes. Nevertheless, due to the vagaries of English, the spellings of many involve more than two letters. For this reason, showing the words' spellings will only confuse the issue for now. The following are examples of two-sound words with initial consonants and long vowels.

day
hay
jay
hay
pay
ray
say
way

bee
fee
gee
he
knee
me
pea
see
she
tea
we

bye
die
guy
hi
lie
my
pie
rye
sigh
tie
why

bow
doe
go
hoe
low
mow
no
row
/r-o/
sew
/s-o/

show
toe
boo
chew
coo
do
goo
moo
shoe
two
who

The following are examples of two-sound words with final consonants and long words:

ace
ache
age
aid
ail
aim
ape
eight

each
ease
eat
eel
ice
oak
oat
own

The following are examples of two-sound words with final consonants and short vowels:

add
am
as
ash
at

Ed
ick
if
in
is
edge

itch
odd
off
up
us
it

Note. From Phonemic Awareness in Young Children: A Classroom Curriculum (pp.73-75), by M.J. Adams, B.R. Foorman, I. Lundberg, and T. Beeler, 1998, Baltimore: Paul H. Brookes Publishing Co. Copyright 1998 by Paul H. Brookes Publishing Co., Inc. Reprinted with permission.

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BIOGRAPHICAL SKETCH

Martha Brown League was born on August 19, 1947, in Montgomery, Alabama, the second of three children. She attended high school in Auburn, Alabama, and graduated from Auburn University with a bachelor's degree in elementary education with an emphasis on mental retardation.

After 2 years of teaching at the elementary level, Martha pursued a master's degree in mental retardation at Florida State University. She spent the next 3 years teaching in regular and special education in Gainesville, Florida. Martha then moved to Virginia, where she taught students with learning disabilities for 3 years. Upon returning to Gainesville, Florida, Martha taught for the next 20 years at the elementary level, teaching all elementary grades, K-6, as well as in the gifted program and in the program for students with emotional handicaps. During this time, she completed a specialist degree in special education, with an emphasis on gifted education, at the University of Florida. Martha has also served as a Curriculum Resource Teacher, a Title I teacher specialist, and as Supervisor of Elementary Curriculum.

Martha presently lives in Gainesville, Florida, with her husband, Roger. They enjoy spending time with each other, their six children, and their extended family.

I certify that I have read this study and that, in my opinion, it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Cecil D. Mercer

Cecil D. Mercer, Chair
Distinguished Professor of Special Education

I certify that I have read this study and that, in my opinion, it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Maureen Conroy

Maureen A. Conroy
Associate Professor of Special Education

I certify that I have read this study and that, in my opinion, it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Holly Lane

Holly B. Lane
Assistant Professor of Special Education

I certify that I have read this study and that, in my opinion, it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

M. David Miller

M. David Miller
Professor of Educational Psychology

This dissertation was submitted to the Graduate Faculty of the College of Education and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 2001

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